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# FURTHER DEVELOPMENT, FABRICATION, AND TESTING OF XM36E1 FUZE SETTER



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U.S. Army Electronics Research
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**Harry Diamond Laboratories**
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This report describes the program undertaken for the further development, assembly, and testing of the XM36E1 Fuze Setter. The program included the fabrication, test, and delivery of three First Article Acceptance Sample (FAAS) and 10 preproduction units that are designed to set the XM587E2/XM724 Electronic Time Fuzes from 0.2 to 199.9 s in 0.1 s increments. Latest design changes

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incorporated in the fuze setter system include: revision of the battery charging circuit to vary charging current over the operating temperature range and provide a charging indication, design and development of a remote probe and coil cable to ease setting of fuzes in various field configurations, redesign of the fuze setter carrying-case assembly to allow packaging of these latest accessory additions, and other minor modifications such as revision of the pulse-width checking circuit, and evaluation of display readout window material. Basic design features and requirements were maintained, such as setting in less than 1 s, display readout of set time, battery-powered operation, low battery indication, and interrogating capability. Other unnecessary functions, such as the self-checking, field-testing capability, were eliminated. Packaging criteria for the fuze setter were maintained to allow hand-held operation and permit functioning in an artillery ground environment. System tests demonstrated that the system complies with the specific technical requirements, while withstanding selected environmental conditions.

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## 1. INTRODUCTION

This report describes the program for further development, assembly, and test of the latest design of the XM36E1 Fuze Setter. The program was comprised of several phases, which were conducted between 1 September 1976 and 31 August 1978. These phases consisted of a review of the basic design characteristics of the fuze setter, an effort to improve fuze setter operation to enhance field usage while maintaining basic requirements, implementation of these design improvements, and assembly and testing of production quantities to verify latest design concepts.

The fuze setter basic characteristics, its operation, and a theoretical description of the system, including timing charts, logic diagrams, and initial development and testing are detailed in previous final reports.[1 2]

Design changes incorporated in the fuze setter system include: revision of the battery charging circuit to vary charging current over the operating temperature range and provide a charging indication, design and development of a remote probe and coil cable to ease setting of fuzes in various field configurations, redesign of the fuze setter carrying-case assembly to allow packaging of these latest accessory additions, and other minor modifications such as revision of the pulse-width checking circuit and evaluation of display readout window material. Basic design features and requirements were maintained, such as setting in less than 1 s, display readout of set time, battery-powered operation, low battery indication, and interrogating capability. Other unnecessary functions, such as self-checking, field-testing capability, were eliminated.

This further development of the fuze setter proved highly successful, yielding an improved fuze setter that was both electronically and environmentally suitable for field usage. This report outlines the objectives of this effort and summarizes the accomplishments toward that end.

## 2. PROGRAM OBJECTIVES

The basic objective of this program was to satisfy all of the technical requirements needed to further develop and test the XM36E1 Fuze Setter. This included a design review with improvement of fuze setter capability and operation as the major goal. It also included revisions of the technical data package

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[1]Development, Fabrication and Test of XM36E1 Fuze Setter, Harry Diamond Laboratories, HDL-CR-75-228-1 (Nov 1975).

[2]Development, Fabrication and Test of XM36E1 Fuze Setter, Harry Diamond Laboratories, HDL-CR-76-020-1 (Nov 1976).

for use in the production of units that could be used in the field. Design and development of additional auxiliary equipment associated with the fuze setter was an extensive part of this program.

The basic tasks to be accomplished were as follows:

(1) Revise the battery charging circuit to vary a charging current over the operating temperature range, in accordance with battery manufacturer's specifications.

(2) Provide a battery charging indicator to inform an operator whenever current from an external source is being supplied to the battery during field use.

(3) Revise the pulse-width checking circuit to allow checking of the fuze oscillator over its specified limits and allow correct setting of all fuzes manufactured to those worst-case limits.

(4) Revise fuze setter mode-setting switch to eliminate self-check capability as a field-test operation function.

(5) Evaluate fuze setter display readout window material and investigate use of grated-type material to further enhance sun-shielding of light-emitting diode (LED) display.

(6) Modify fuze setter package to allow incorporation of latest circuit designs while maintaining environmental ruggedness.

(7) Design, fabricate, test, and deliver 13 remote probes to allow operator ease of setting fuzes in various field configurations.

(8) Design, fabricate, test, and deliver 13 coil cables to mate the existing fuze setter remote probe connector to the newly designed remote probe.

(9) Redesign, fabricate, test, and deliver 13 carrying cases for the fuze setter and its associated equipment (including remote probe and coil cable), using a modified standard ammunition can.

(10) Fabricate, test and deliver three fuze setters for submission as a First Article Acceptance Sample (FAAS), subjecting them to the following environmental tests:

a. Low temperature

b. High temperature

c. Leakage (immersion)

d. Dust (fine sand)

e. Humidity

f. Electromagnetic interference

g. Vibration (bounce)

h. Shock (drop)

Part of the shock and vibration test should include testing within the carrying-case with the fuze setter accessories.

(11) Fabricate, test, and deliver 10 fuze setters as a Development Test/Operational Test (DT-II/OT-II) preproduction sample, subjecting them to low and high-temperature environments.

## 3. WORK ACCOMPLISHED

### 3.1 General

The program commenced on 1 September 1976. It should be noted that this program was a continuation of previous efforts under contract No. DAAG39-76-C-0020. Since other system delays allowed additional time for further development, this interim period was used to improve fuze setter operation, thereby enhancing the practicality of its use in the field. Previous organization of the program and assignment of task responsibilities remained essentially the same. The majority of the personnel assigned to the program were those already familiar with the project and who had been associated with the previous efforts for Harry Diamond Laboratories (HDL) as mentioned above and under contracts DAAG39-73-C-0024 and DAAG39-73-C-0228.

### 3.2 Battery Charging Circuit Revision with Charging Indicator

The battery charging circuit for the fuze setter was investigated with the intent of controlling the battery charging current over the operating temperature range of -45° to +145°F. An up-to-date battery charging current specification was obtained from the battery manufacturer. Various circuits were reviewed, with the aid of HDL personnel, which would regulate the charging

current as required. The circuit which is employed in the fuze setter is shown in figures 1 and 2. Component reference designations are in accordance with those of the fuze setter schematic, Drawing No. 11711327.

Figure 1 shows the power supply and charging indicator portion of the circuit. This design allows a charging power source of between 20 and 40 V to be used. A current regulator diode, CR27, is employed to supply less than 1 mA to zener diode voltage regulator, VR5. A voltage reference, $V_Z$, of 6.8 V is thereby created and used as a reference by operational amplifier (op-amp) U1-10. The output of this op-amp is used to provide a high-current regulated voltage, $V_R$, via transistor 1Q1. This $V_R$ voltage, in turn, is used to supply a constant current of less than 10 mA to the battery via a light-emitting diode (LED) segment of display 1A1U3. The LED segment provides a visual indication of the battery being charged whenever the external vehicle power source is connected. The high-current regulated voltage, $V_R$, is also supplied to the digital current control circuit shown in figure 2. This circuit consists of four binary transistor switches, Q27 through Q30. These switches are each driven by an op-amp, the output of which changes state at various temperatures. These temperatures are determined by voltage divider networks consisting of the precision resistors shown and a temperature sensing thermistor 1RT1.

Current-limiting resistors R51, R55, R59, and R65 are selected to divide the battery charging current into 16 steps controlled by the four binary switches. Worst-case currents and temperatures are listed in table 1 for the 16 digital codes. Also listed are total circuit currents required from the power source. The worst-case, maximum and minimum 16 current steps over the temperature range have been graphically plotted and are shown in figure 3. These steps are shown to be within the battery manufacturer's specifications.

Also provided in the digital control circuitry are two current-limiting transistor switches, Q31 and Q32. Op-amp U3-12 senses a temperature of approximately +140°F and turns off the four binary switches (by switching off the four op-amp voltage divider resistors) when temperatures exceed those at which the battery may be charged. Also, by switching off the two most significant binary switches, via transistor Q32, when the fuze setter mode switch is in the OFF position, battery charging current is limited to less than 60 mA, as required when the battery has been subjected to long-term storage. These current and temperature limitations are shown graphically in figure 3.

Other circuit provisions include a voltage transient suppressor, VR6, to suppress voltage transients which may be present

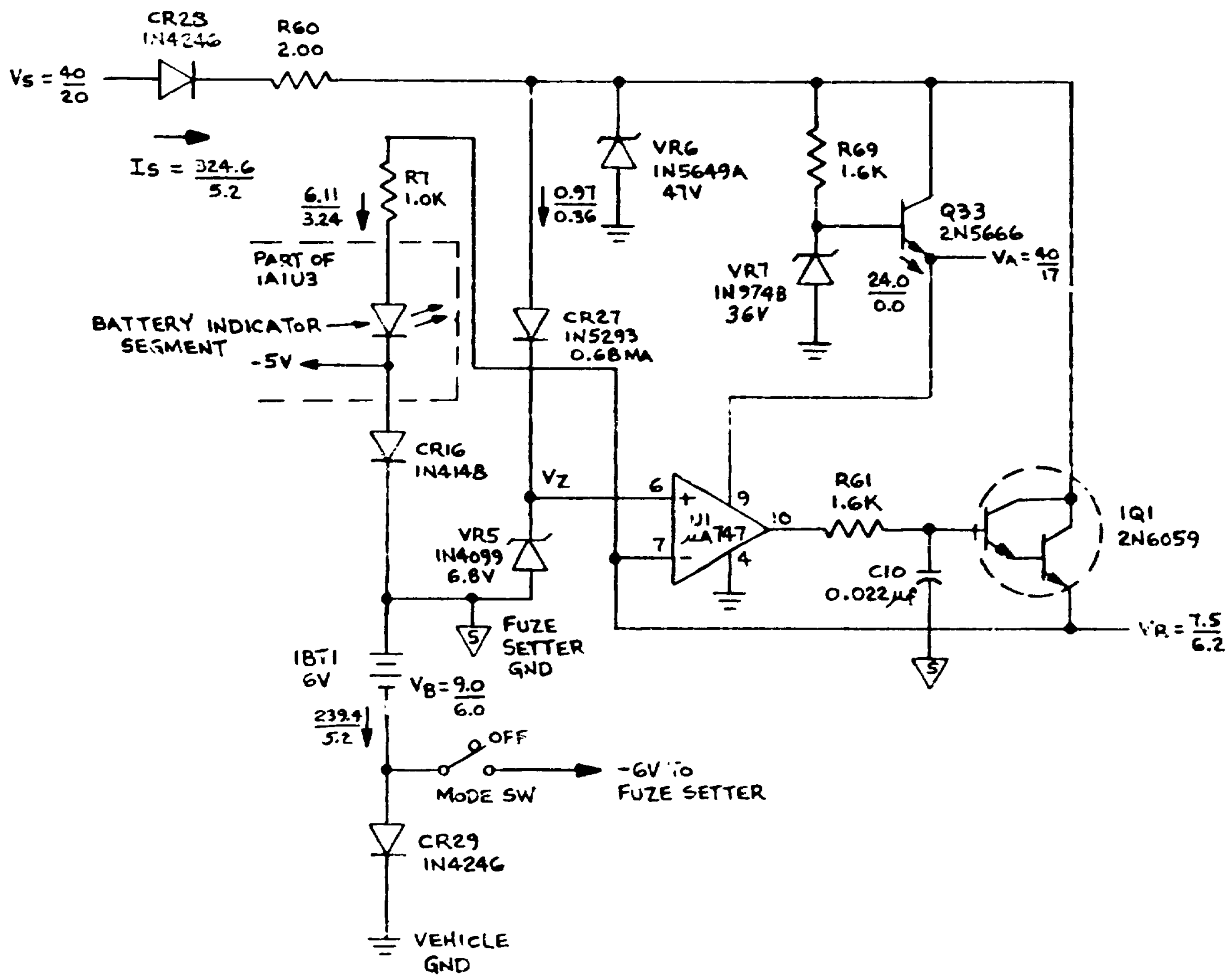


Figure 1. Battery charging circuit--power supply with indicator.

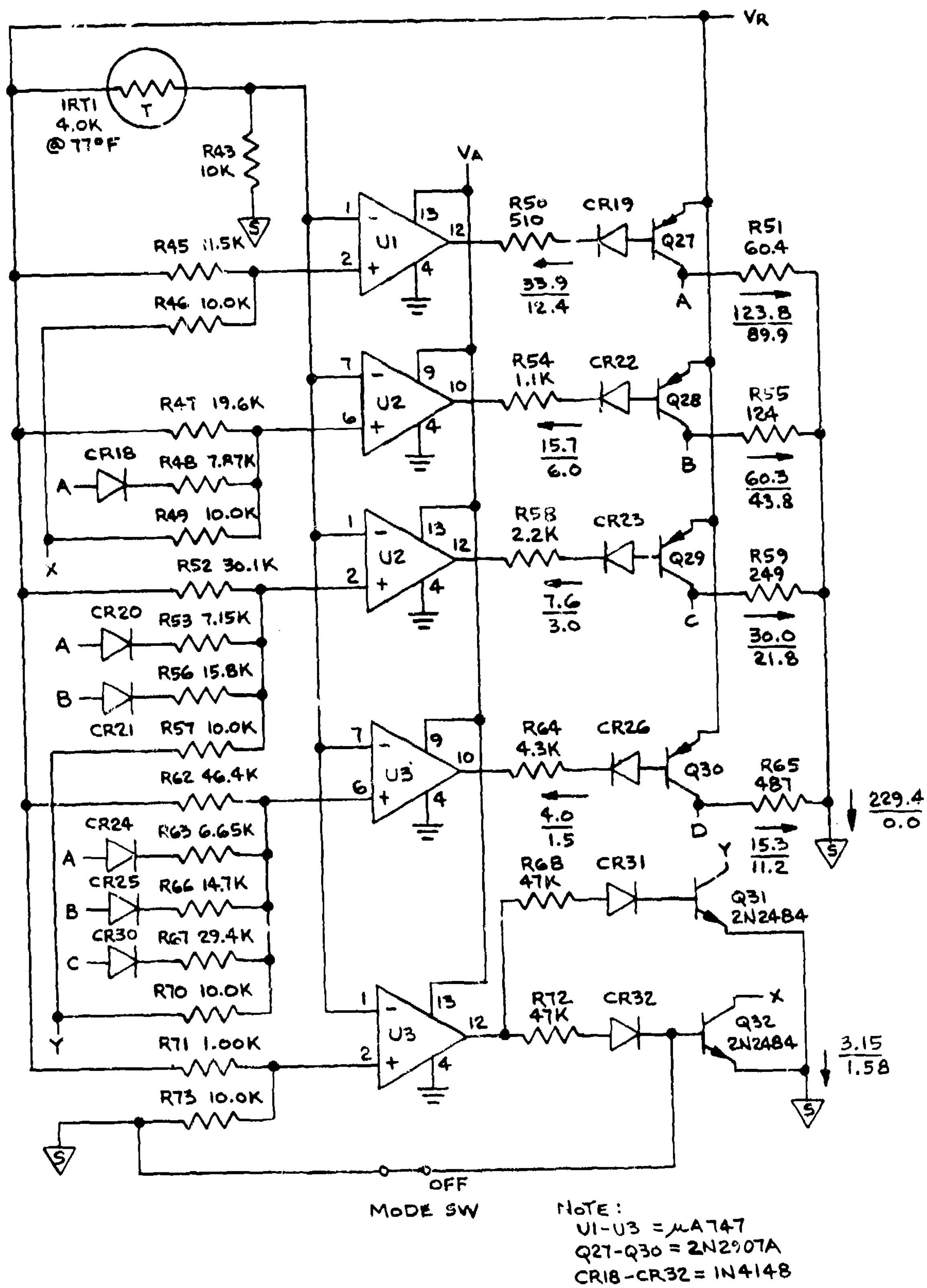


Figure 2. Battery charging circuit--digital current control.

## TABLE 1. BATTERY CHARGE SPECIFICATION LIMITS

| Digital Code | Battery Charge Current (mA) | | Temperature(°F) | | Vehicle Source Current (mA) | |
|---|---|---|---|---|---|---|
| A B C D | MAX | MIN | MAX | MIN | MAX c | MIN |
| 0 0 0 0 | 10.0 a | 5.2 | -40 | -40 | 34.0 | 5.2 |
| 0 0 0 1 | 25.3 | 16.4 | + 7 | -11 | 53.3 | 17.9 |
| 0 0 1 0 | 40.0 | 27.0 | +18 | + 1 | 71.6 | 30.0 |
| 0 0 1 1 | 55.3 b | 38.2 | +29 | +10 | 90.9 | 42.7 |
| 0 1 0 0 | 70.3 | 49.0 | +30 | +15 | 110.0 | 55.0 |
| 0 1 0 1 | 85.6 | 60.2 | +42 | +23 | 129.3 | 67.7 |
| 0 1 1 0 | 100.3 | 70.8 | +45 | +26 | 147.6 | 79.8 |
| 0 1 1 1 | 115.6 | 82.0 | +46 | +31 | 166.9 | 92.5 |
| 1 0 0 0 | 133.8 | 95.1 | +46 | +34 | 191.7 | 107.5 |
| 1 0 0 1 | 149.1 | 106.3 | +63 | +39 | 211.0 | 120.2 |
| 1 0 1 0 | 163.8 | 116.9 | +63 | +41 | 229.3 | 132.3 |
| 1 0 1 1 | 179.1 | 128.1 | +65 | +43 | 248.6 | 145.0 |
| 1 1 0 0 | 194.1 | 138.9 | +65 | +44 | 267.7 | 157.3 |
| 1 1 0 1 | 209.4 | 150.1 | +73 | +46 | 287.0 | 170.0 |
| 1 1 1 0 | 224.1 | 160.7 | +73 | +48 | 305.3 | 182.1 |
| 1 1 1 1 | 239.4 | 171.9 | +76 | +49 | 324.6 | 194.8 |

a. MAX CURRENT WHEN TEMPERATURE IS GREATER THAN +145°F.

b. MAX CURRENT IN OFF MODE POSITION.

c. MAX CURRENT WHEN VEHICLE SOURCE VOLTAGE IS LESS THAN 40V.

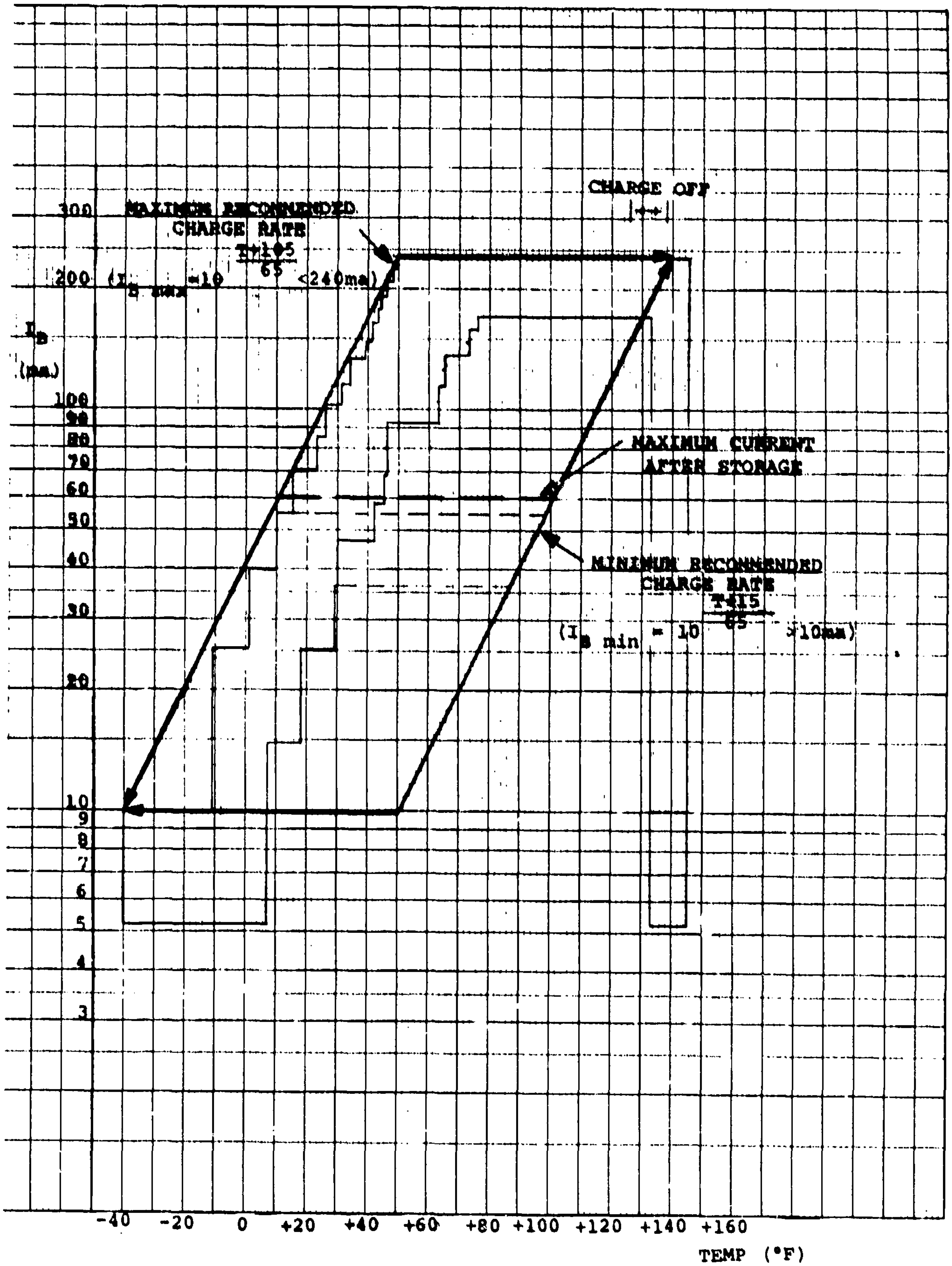


Figure 3. Battery charge characteristics.

from the external charging source; a voltage regulator, consisting of VR7 and Q33, to protect the op-amps; and diodes CR28 and CR29, to protect the circuitry against reverse polarity of the charging source and current limiting when connection is made between the fuze setter ground and vehicle ground.

The complete battery charging circuit as exists in the fuze setter may be seen in the detailed logic diagrams shown in figures 4, 5, and 6.

Other battery charging circuit modifications were considered to provide a battery charge capability over the operating temperature range. Since charging current at low temperatures must be limited to relatively low magnitudes, the charging time to fully recharge a battery becomes lengthy. To decrease this charging time, a battery heater circuit was designed which would increase the battery temperature at low temperatures and therefore allow the battery charging current to be increased.

Several heater designs were devised, such as "heating pads", which would be assembled externally on each side of the battery package within the fuze setter. An alternate design used "cylindrical heaters", which would be inserted around each battery case. A new battery package was designed to contain these cylindrical heaters and preliminary drawings were produced. Both thermistors and mechanical thermostatic switches were investigated to sense battery temperature and control the heater on/off cycling.

A review of all of the battery heater design possibilities was conducted. It was found that the "cylindrical heaters" were significantly more efficient than the "heating pads", but still required approximately one hour to raise the battery temperature from -40° to +80°F. This temperature increase, however, would require approximately 20 w of external power from the vehicle charging source. Since this power would be required for several hours, it was decided not to employ a battery heater in the fuze setter.

### 3.3 Battery Charging Tests

The battery charging circuit was tested to simulate temperature variations. A variable resistance was substituted for the temperature-sensing thermistor. The four binary switches were monitored in addition to the battery charging current. These values were recorded and, when plotted against the graphical limits of figure 3, the circuit was found to operate as specified.

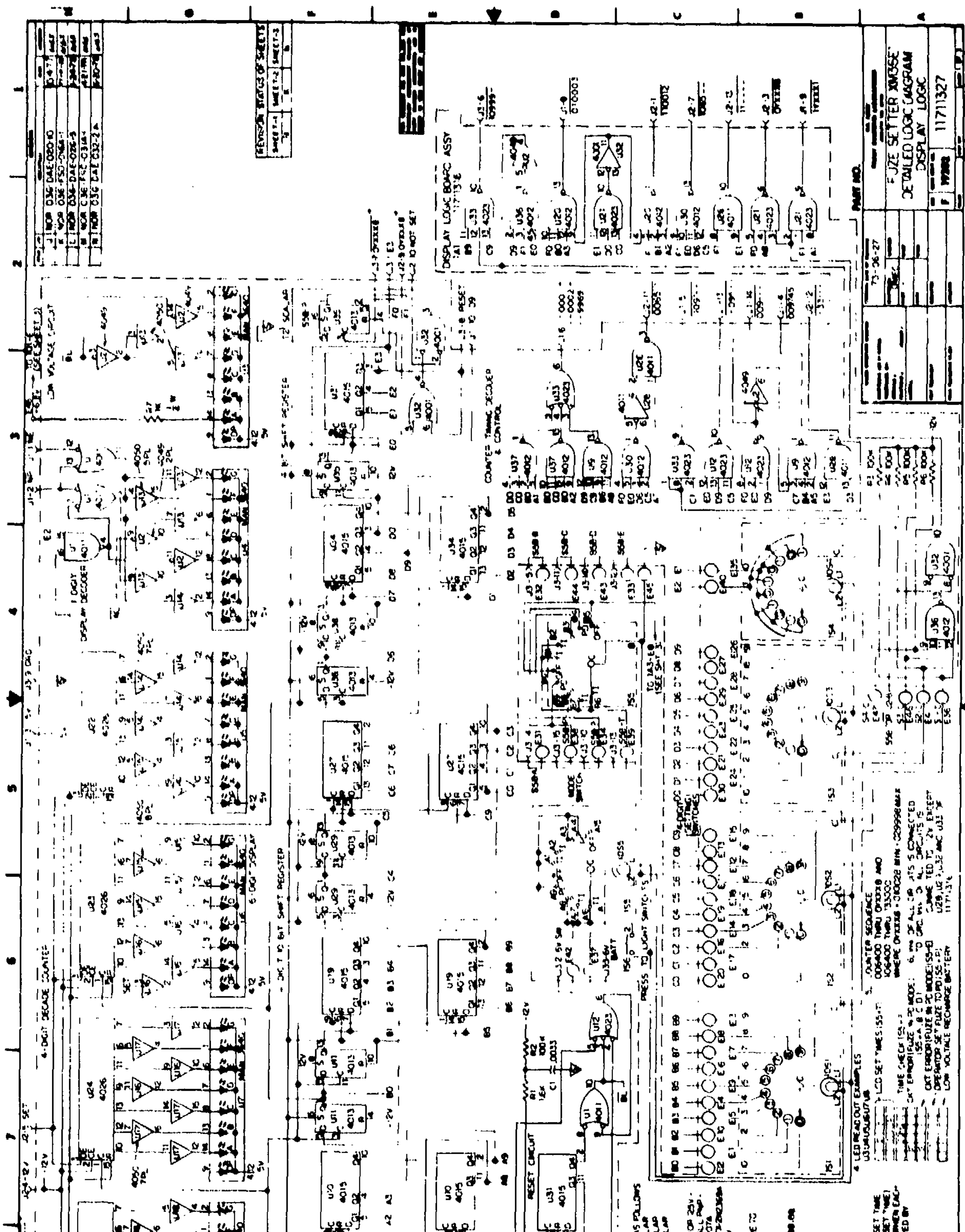

Figure 4. Detailed logic diagram of display logic.

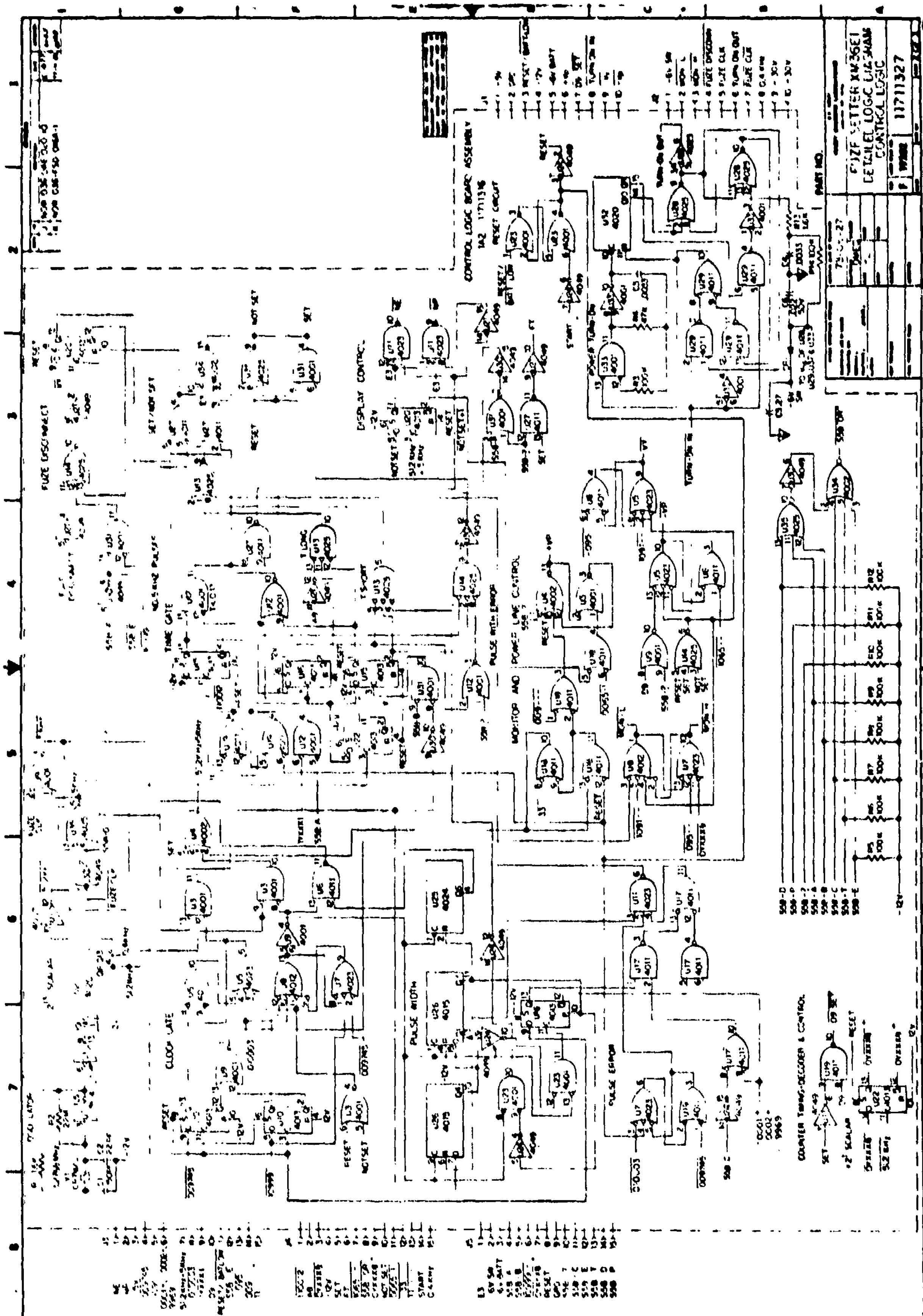


Figure 5. Detailed logic diagram of control logic.

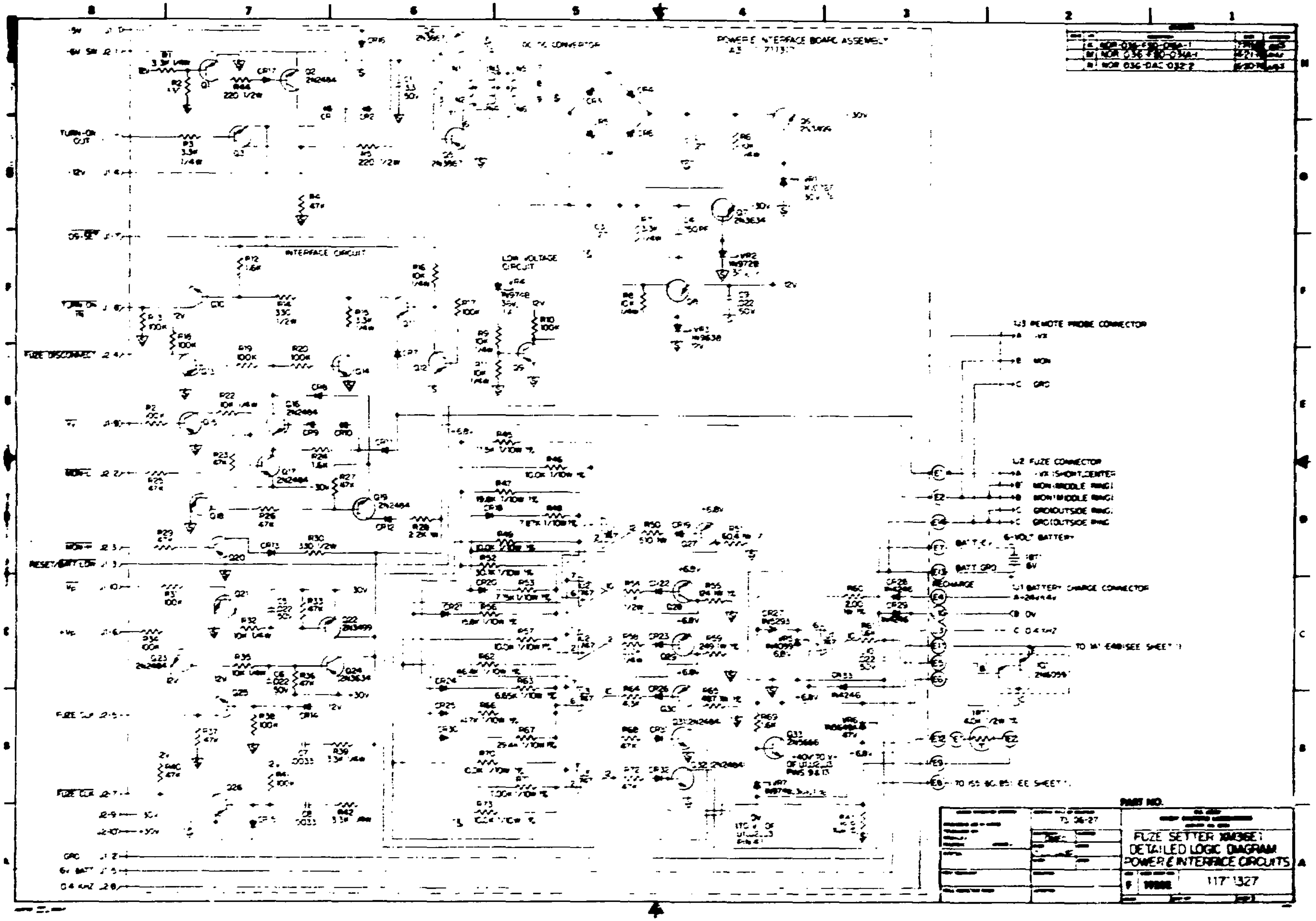


Figure 6. Detailed logic diagram of power and interface circuits.

Actual battery charging tests were also performed. Batteries of several fuze setters were charged at ambient temperatures and at the operating temperature extremes. The fuze setters were then operated to determine the number of fuze settings per charge, both without and with an "L" indication. The resultant number of settings at ambient and high temperatures well exceeded the specified quantities. Low-temperature operating results, however, have been extremely poor and further investigation is currently being conducted.

The fuze setter test equipment was modified to perform the battery discharge tests to determine the number of settings per charge. A circuit was designed that contained a solid-state light sensor, to sense the "L" and set-time number (#) and digital decimal counters. This circuit is shown as part of figure 7. The test setup to perform these battery tests is shown in figure 8.

This circuitry, required to perform the battery tests, was added to the existing fuze setter test equipment. The original circuit contained a 2 kHz oscillator and logic circuits to sense the presence and absence of the fuze setter 0.4-kHz test frequency signal. [3] This oscillator signal was employed as the time base for the new circuitry.

The new circuitry consists of a dividing flip-flop and counter to provide delay times as long as 9 hours, decoding and logic gates to provide switching signals to automatically operate the fuze setter at various duty cycles, a relay to interface the fuze to the fuze setter and switch battery charging current, light-sensing phototransistor circuits to sense the illumination of the fuze setter LED display, and decimal counters and associated readouts to count and display the number of fuze settings and number of fuze settings with an "L".

Flip-flop U9, counter U4, and-gate U6-13, and inverter U1-10 provide 2-s on/30-s off and 2-s on/2-s off signals. These rates were chosen to operate the fuze setter to discharge the fuze setter battery. Through and-gate U7-4 these signals are used, to operate a relay which simulates the manually made electrical connection of the Vx signal between the fuze and fuze setter. Phototransistor Q1 senses the presence of the LED set-time number (#) display and, via transistors Q2 and Q3 and Schmitt trigger gates U8-11 and U8-3, this presence event is counted and displayed on the "#" counter circuit U10 through U17. Similarly,

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[3]Technical Manual, Fuze Setter: XM36E1, Test Equipment (Part Number 11711393); Harry Diamond Laboratories, TL-EM-97-1 (24 September 1976).

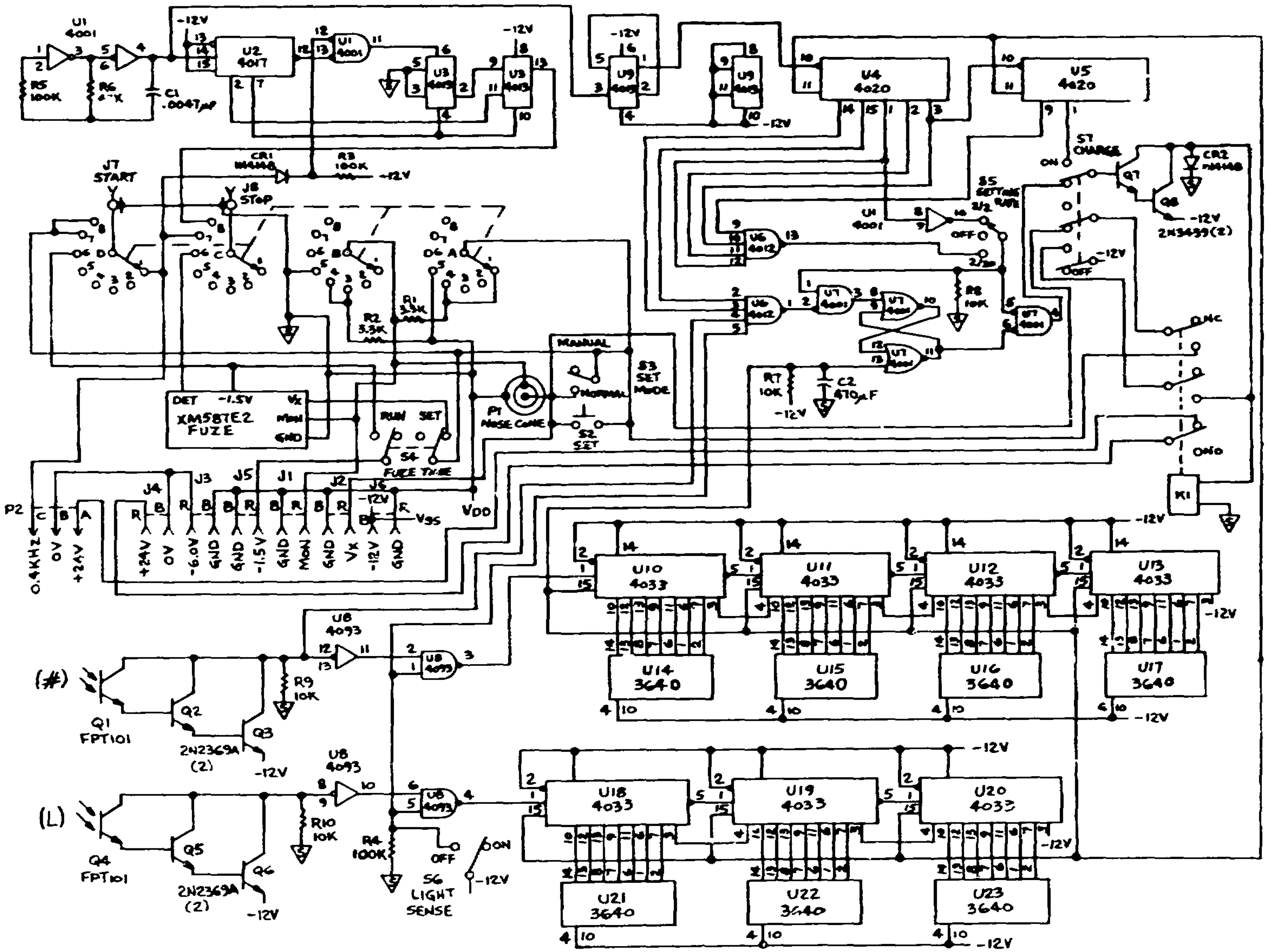

Figure 7. Test equipment schematic with battery test circuit.

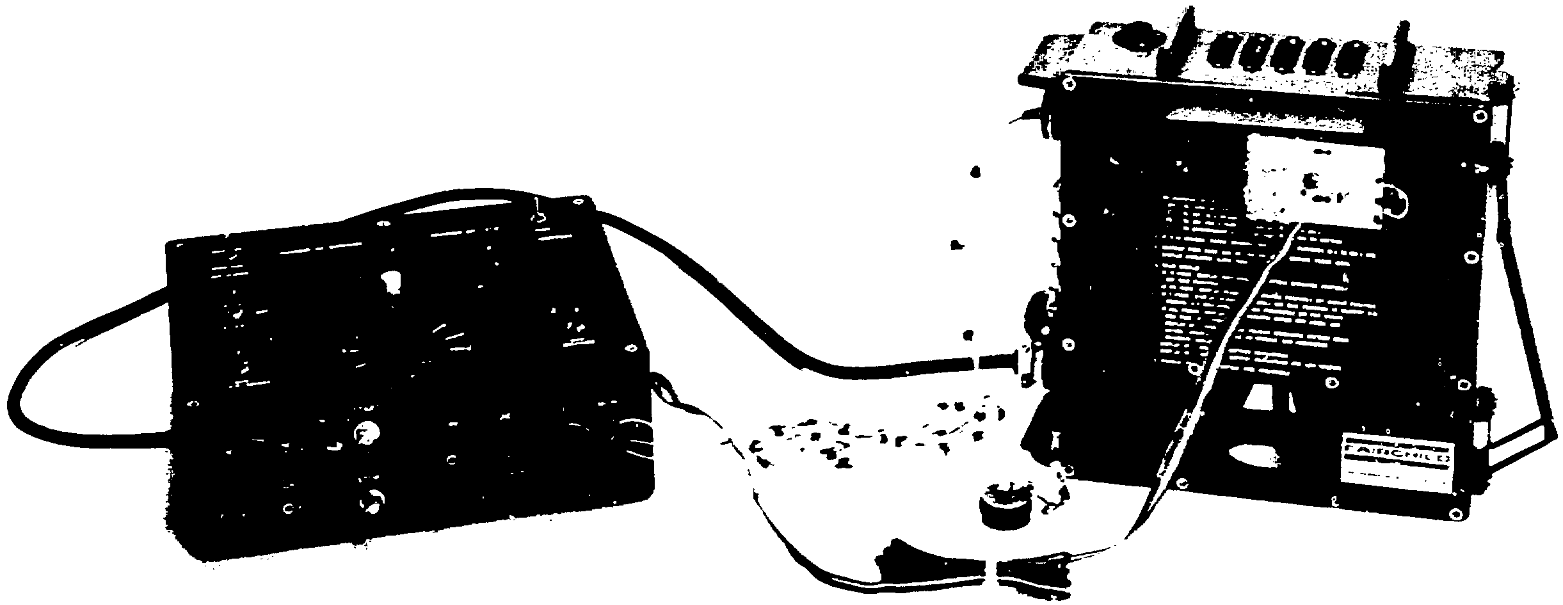


Figure 8. Battery test setup.

phototransistor Q4 senses the presence of the LED "L" display and, via transistors Q5 and Q6 and Schmitt trigger gates U8-10 and U8-4, this presence event is counted and displayed in the "L" counter circuit U18 through U23.

And-gate U6-1 decodes a timing pulse whose duration is the last 1/2-s of the 2-s on time. Since the LED "#" display is normally present during this time, a signal derived at phototransistor Q1 normally inhibits the 1/2-s pulse. When the fuze setter battery is discharged to the point where a number is no longer displayed ("L" only), the 1/2-s pulse from and-gate U6-1 is allowed to set cross-coupled flip-flop U7-10/U7-11, via and-gate U7-3. This flip-flop in turn inhibits and-gate U7-4 from activating the relay, thereby ceasing further operation of the fuze setter.

In addition to automatic operation of the fuze setter to discharge the battery, circuitry is provided to automatically charge the fuze setter for a period of 9 hours. The nine-hour signal is derived from counter U5 and with the use of the charge switch, causes the relay to latch and open-circuit the charging current path.

Other miscellaneous circuitry has been designed to provide self-explanatory functions, such as pull-up resistors, relay-driving transistors, and an RC reset circuit. Switches are provided to charge the battery, select the automatic fuze setter operating rate of 2/30 or 2/2, and to disable the LED photosensing circuit.

### 3.4 Battery Charging Cable Revision

The battery charging cable was revised to improve the performance of the cable plug connector which mates with the vehicle receptable connector. Since the vehicle connector was fixed (part of military logistics), the mating connector plug design was modified to make it more rugged and allow it to be used with arctic mittens. An adapter was added to provide for a cable clamp that would adequately support the cable. This adapter also extended this connector plug end to allow insertion into and disconnection from the vehicle by an operator wearing arctic mittens. This new battery charging cable is shown in figure 9.

A 10-ft battery charging cable was fabricated, tested, and delivered for each of the 13 fuze setters. These cables, which normally connect the fuze setter to the 24-V power source contained on military vehicles and self-propelled guns, were tested so that when 45 Vdc was applied at one end and a load requiring 300 mA was connected to the other end, a maximum voltage drop

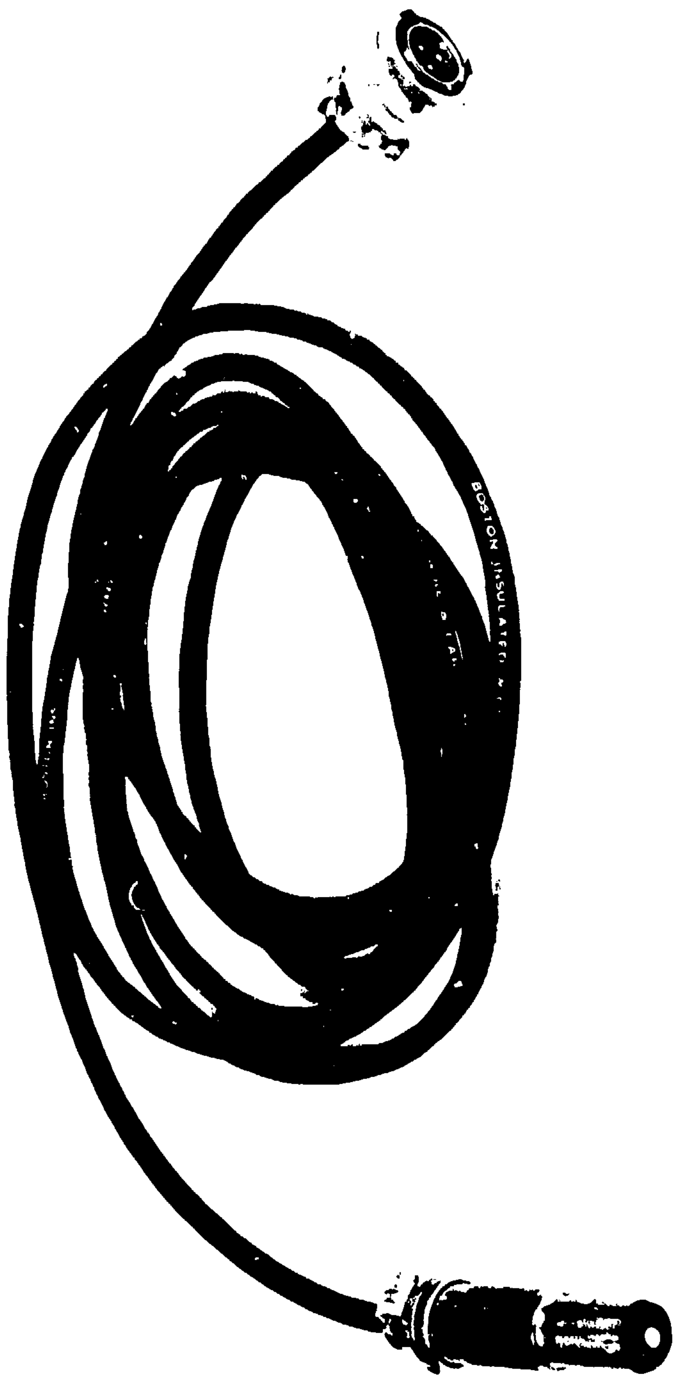

Figure 9. Battery charging cable.

was measured in the cable of significantly less than 0.5 V. Each cable was employed at various times during the testing of the fuze setter to actually charge the fuze setter battery, thereby verifying successful, correct operation in actual use.

### 3.5 Pulse-Width Circuit Revision

The pulse-width circuitry was revised to allow correct setting of all fuzes with fuze oscillators manufactured within worst-case limits. A timing pulse, Q4, derived at shift-register output 1A2U26-2 (see figure 5), is employed to check the lower limit of the actual fuze set-time accuracy verification. This timing pulse is employed to provide an error signal via the T-SHORT and-gate 1A2U13-6 when the "coincidence pulse" on the monitor line exceeds this lower limit.

In the original pulse-width circuit, the Q4 pulse was generated at a minimum of six fuze setter oscillator periods after the leading edge of the "coincidence pulse".[1] This is equivalent to a set-time accuracy lower limit of T-0.05 s. Since the fuze oscillator can be within specification and cause the set-time accuracy lower limit to be equal to T-0.06 s, the Q4 timing pulse was required to be generated at one additional fuze setter oscillator period later in time. Since no additional shift-register outputs were available to generate this pulse later in time, a pulse-width circuit revision was required.

The revised pulse-width circuit is shown as part of figure 5. The new timing diagram for this circuit is shown in figure 10. It can be seen from this diagram that the Q4 pulse is now generated at a minimum of seven fuze setter oscillator periods as required. The half and quarter pulse-width check, which is the primary function of this circuit, has the same timing characteristics as the original circuit: Half-period pulses are required to be greater than 88 μs and quarter-period pulses are required to be less than 68 μs. However, this new pulse-width circuit design also requires the half-pulse width to be less than 117 μs. This new requirement acts as an additional check on the fuze oscillator, thereby enhancing system verification.

### 3.6 Mode-Setting Switch Revision

The mode-setting switch was revised to eliminate the self-check capability as a field-test operation function. These switch positions were deemed unnecessary for operator use, since field testing is not a normally performed function.

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[1]Development, Fabrication and Test of XM36E1 Fuze Setter, Harry Diamond Laboratories, HDL-CR-75-223-1 (Nov 1975).

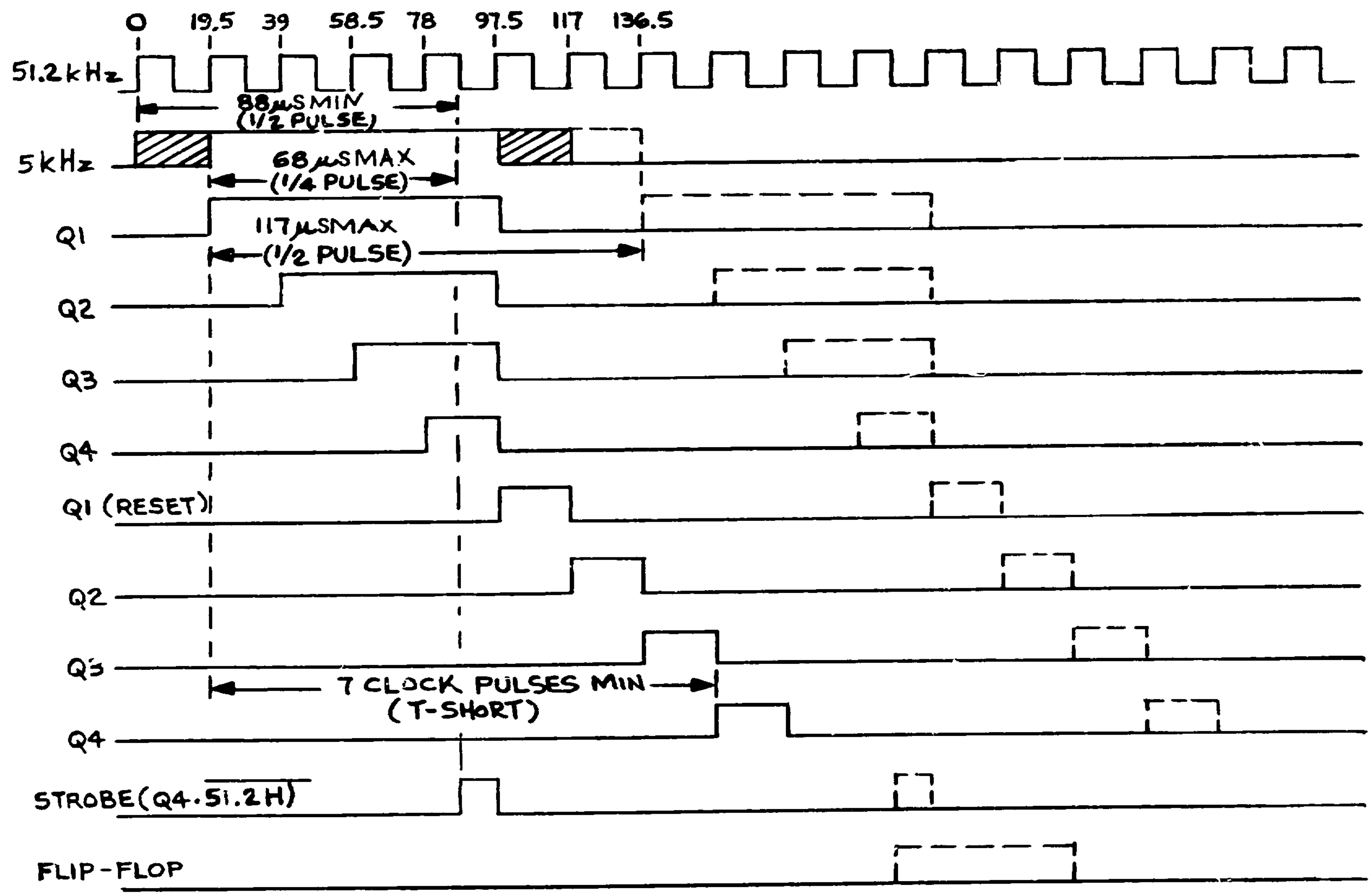


Figure 10. Pulse-width timing diagram.

The mode switch nomenclature was also revised to clarify switch position meaning. The dial reading of OFF is now self-explanatory. The TI indication abbreviates the time function, the ? indication symbolizes the interrogate function, and the PD indication abbreviates the point-detonation function. Since 10 switch positions are available, redundant dial indications, allowing corresponding functions, were employed as follows: OFF, TI, TI, ?, PD, OFF, TI, TI, ?, PD.

### 3.7 Display Window Material Evaluation

The display window material was evaluated, and an investigation was performed on the effectiveness of a grated-type window material. Various parameters of grated-type material were studied to yield a display readout window which would further enhance the sun shielding of the LED display.

An analytical study showed that the angle of shielding provided by this material would not aid in preventing the shading of sunlight and that the hood, which is part of the front panel casting, provides a greater angle of shielding than the grated-type material. It was also found that the grating caused the operator's view to be partially blocked as the display was observed at an angle normal to the front panel.

Fuze Setters S/N 303 and 304 have been fabricated with this grated-type material. The fin . decision as to which material is employed in a production quantity is reserved for further evaluation during field user testing.

### 3.8 Packaging Modifications

The latest design of the XM36E1 Fuze Setter was revised to include several packaging modifications. These modifications were incorporated into units S/N 216, 217, and 301 through 311. Figures 11 through 17 illustrate the various features of the fuze setter.

Figure 11 shows the revised mode-setting switch. This switch now contains the following nomenclature: OFF, TI, ?, and PD. The previous switch contained over-abbreviated terminology which may have led to operator confusion.

Shown in figure 12 is the remote probe connector which allows operation with the remote probe via the coil cable. Also, the alternate grated-type window material can be seen and the battery charge indicator becomes visible through this window when an external source supplies charging current to the fuze setter battery via the battery charge connector.

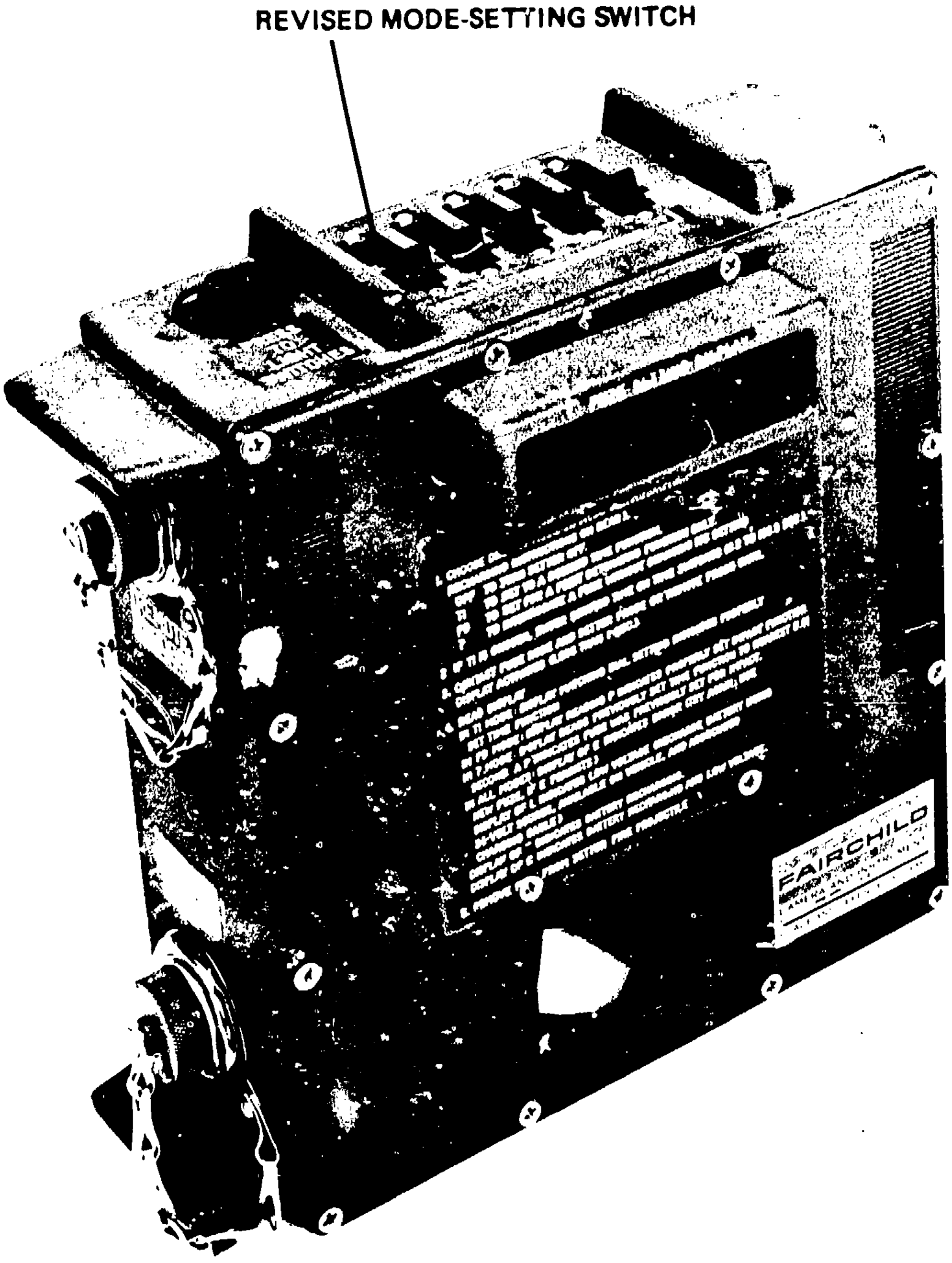


Figure 11. XM36E1 fuze setter--front and top views.

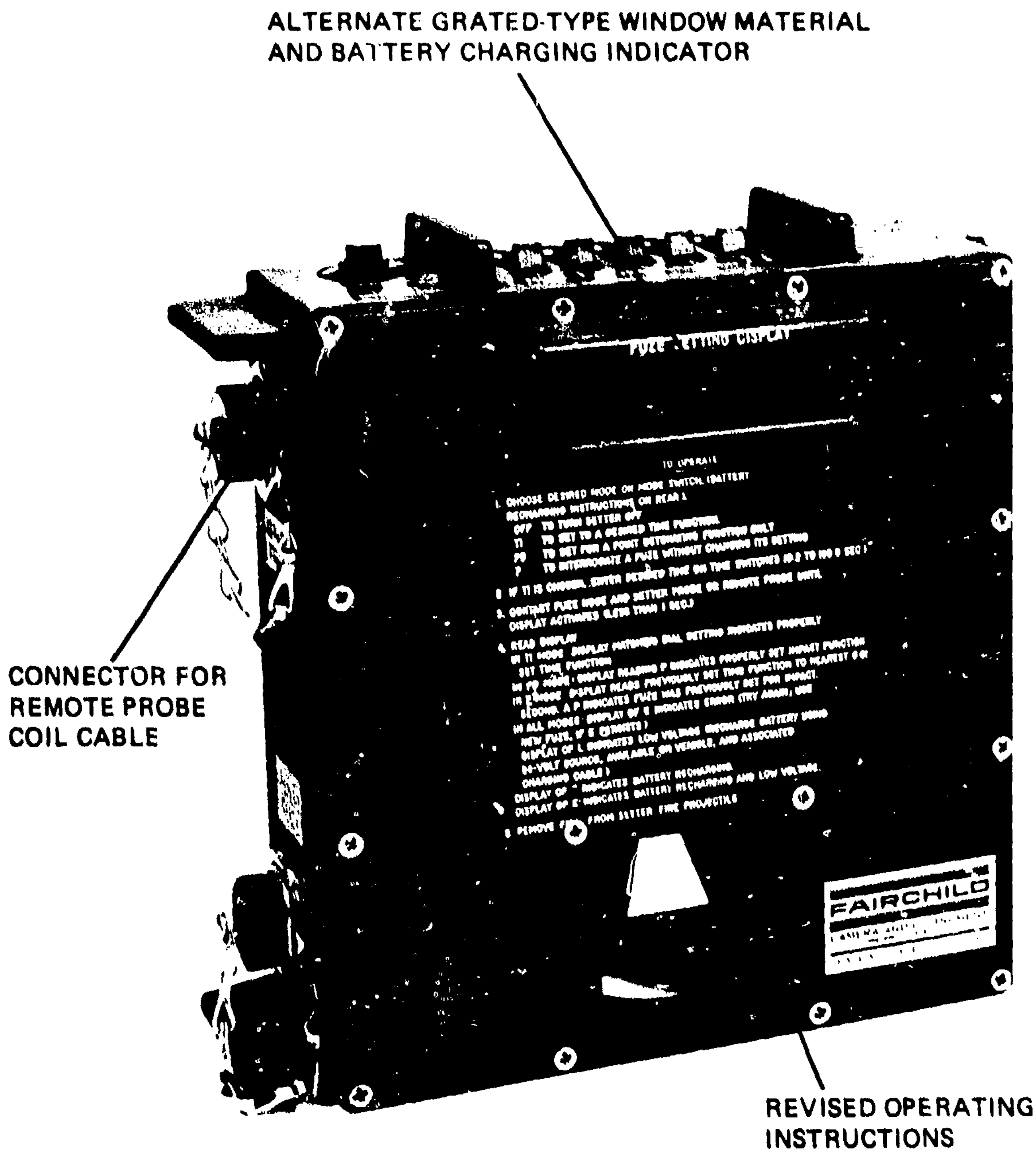


Figure 12. XM36E1 fuze setter--front and side views.

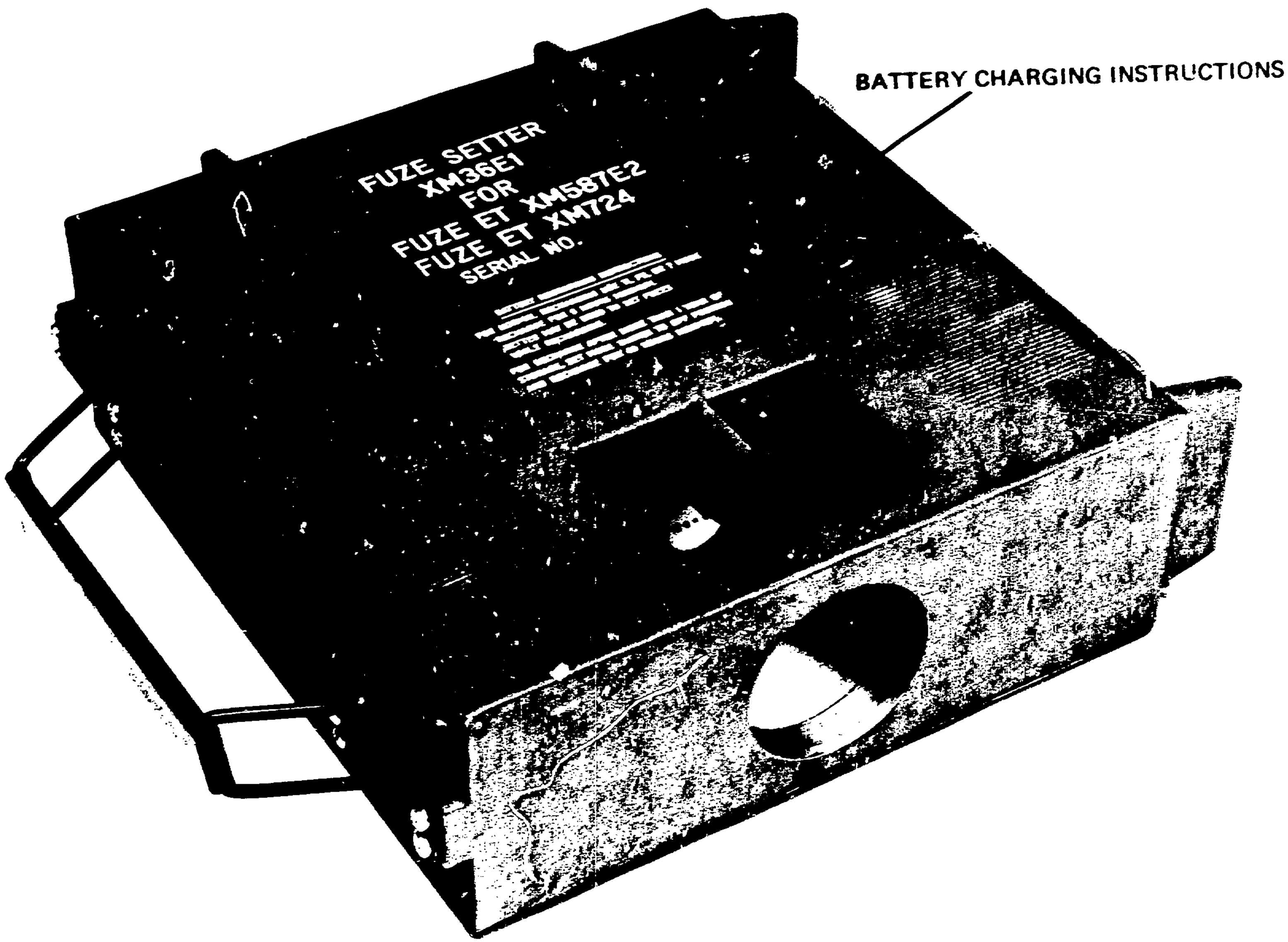


Figure 13. XM36E1 fuze setter--rear and bottom views.

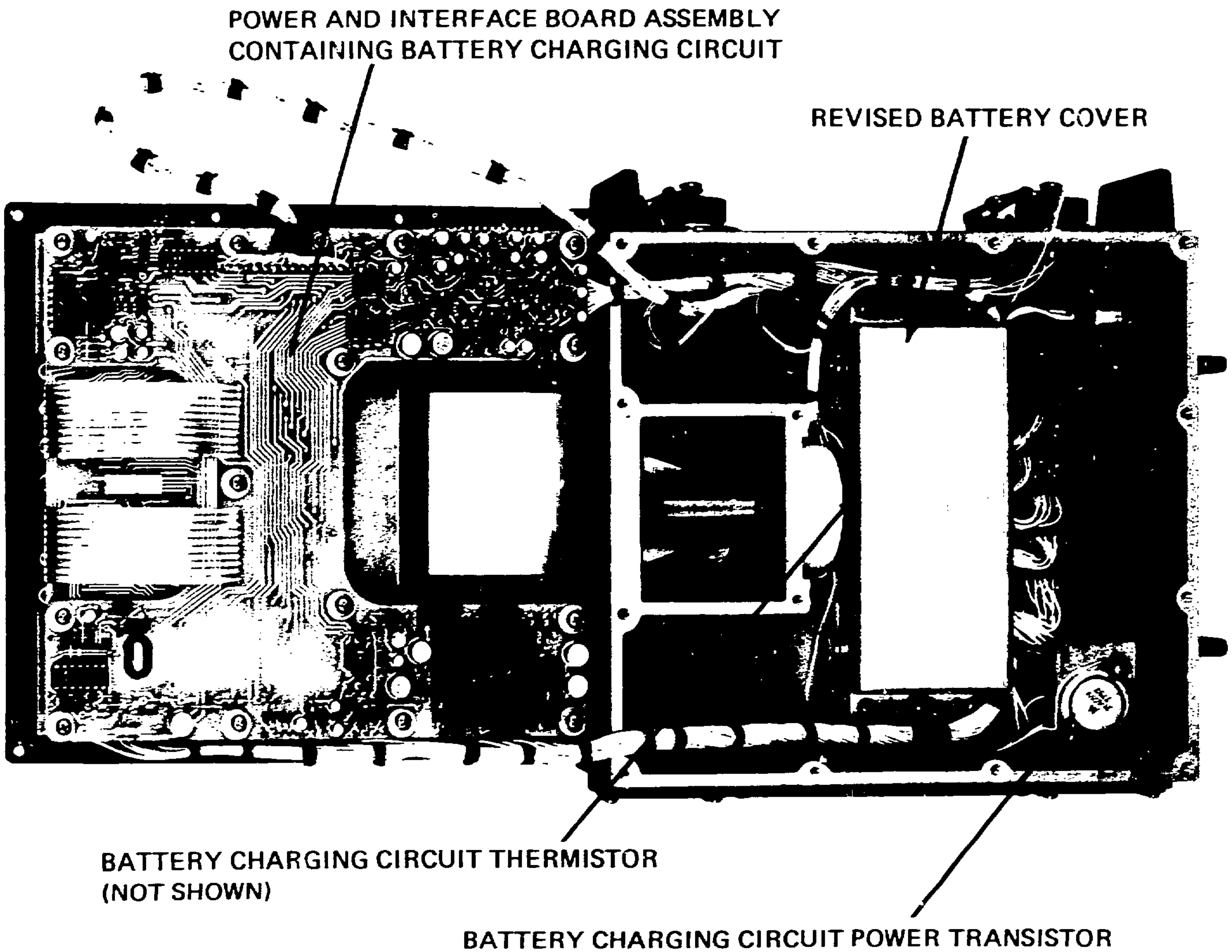


Figure 14. XM36E1 fuze setter--internal view.

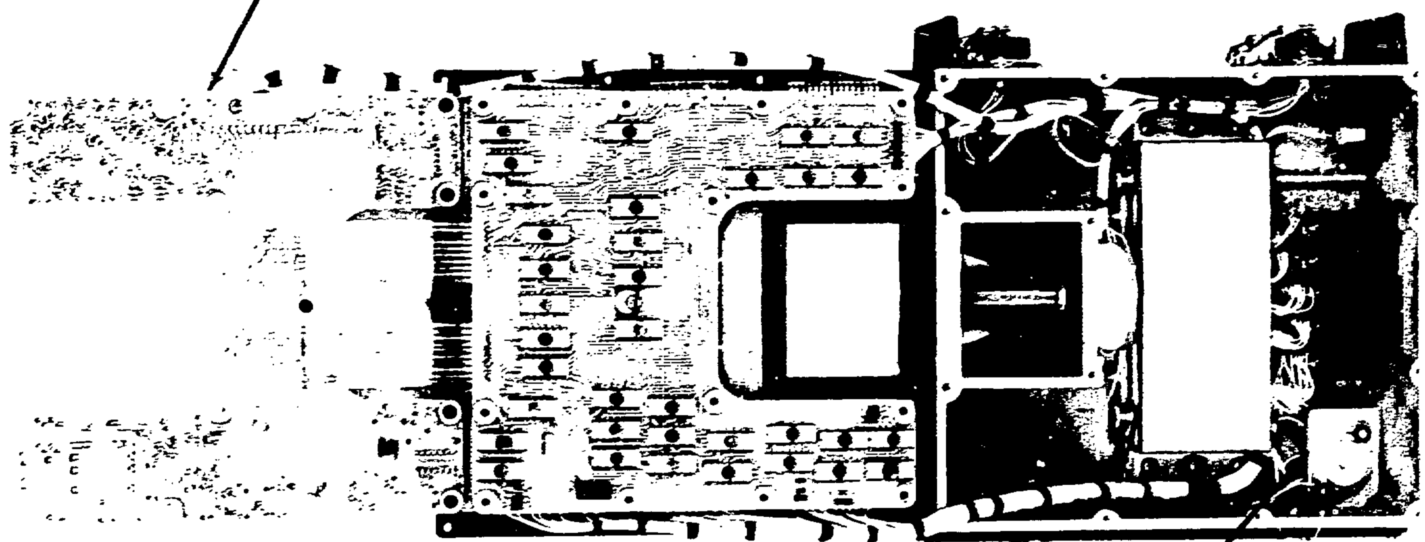


Figure 15. XM36E1 fuze setter--partial disassembly.

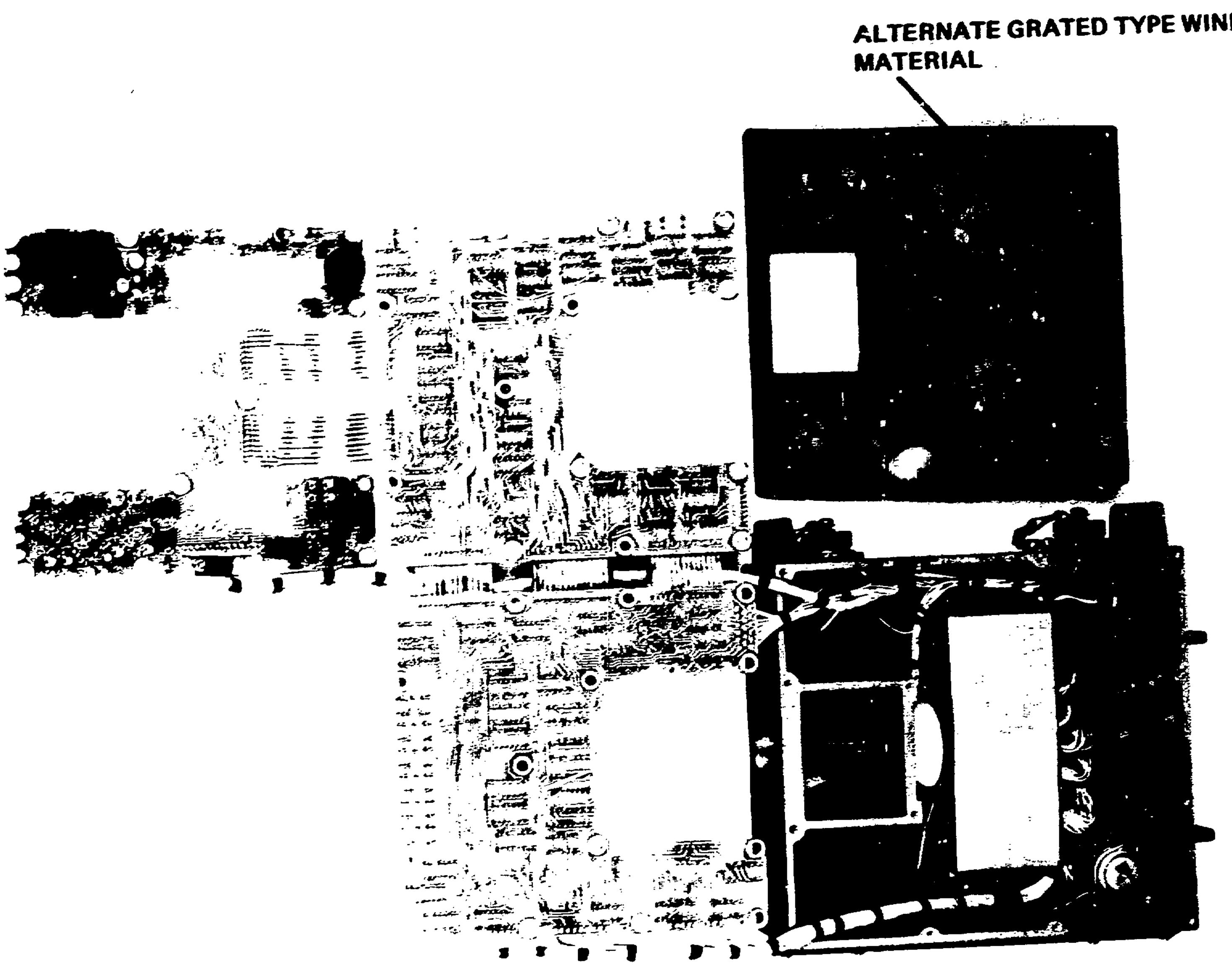


Figure 16. XM36E1 fuze setter with panel removed--top view.

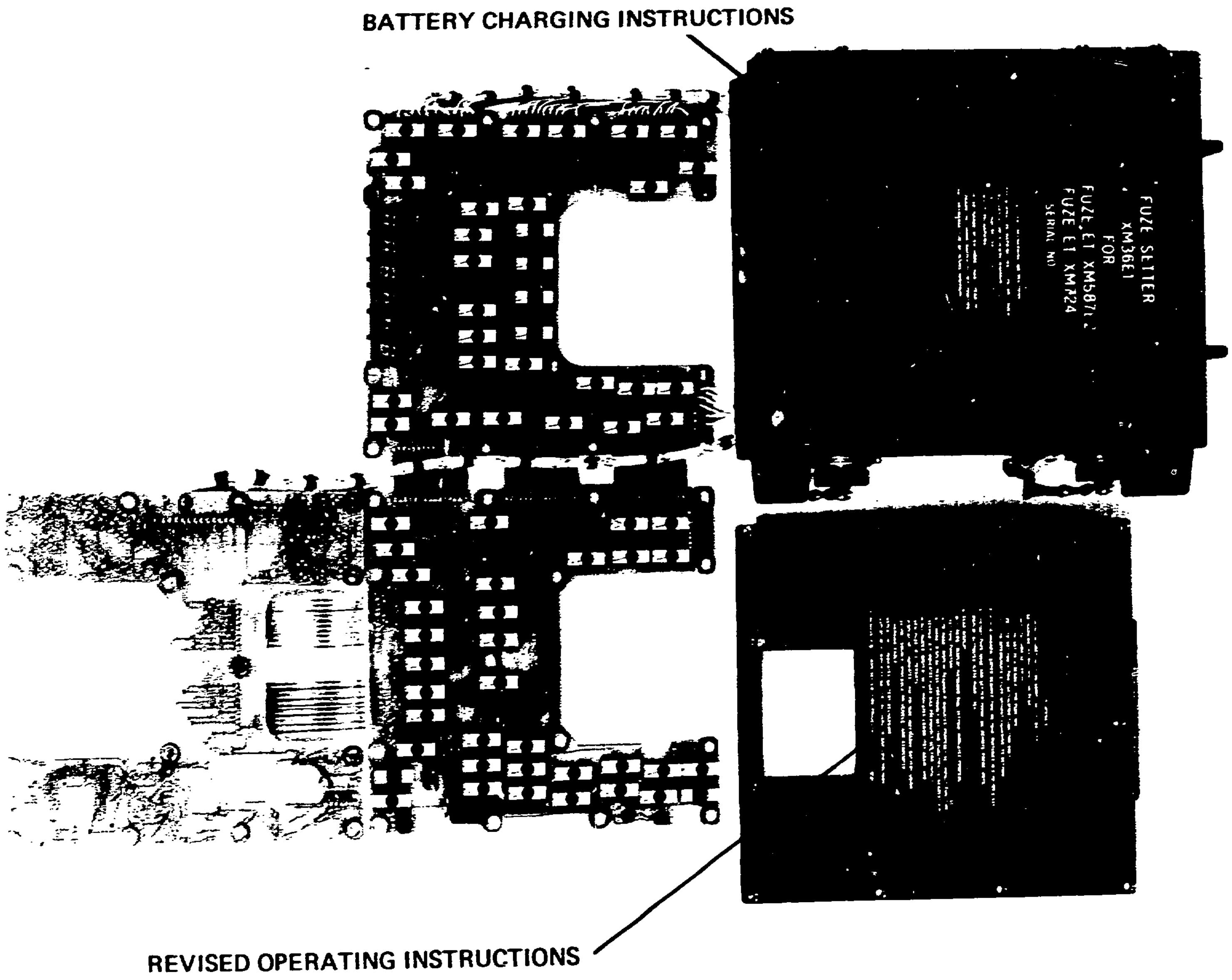


Figure 17. XM36E1 fuze setter with panel removed--bottom view.

Figure 12 also shows the revised operating instructions. These instructions include all pertinent information for field operation, thereby eliminating the need for an operator manual. As indicated, the battery recharging instructions are located in the rear of the fuze setter and are depicted in figure 13.

Figure 14 shows the revised battery cover. Clearance holes in this cover were eliminated since they were no longer needed due to the increase in overall fuze setter package size. The addition of the latest battery charging circuit design required this increased package size. This circuit is basically contained on the Power and Interface Board Assembly as shown in figures 14 and 15. The thermistor and power transistor for this charging circuit may also be seen in these figures.

Figures 16 and 17 illustrate the fully disassembled fuze setter. The feature of having all components easily accessible for possible troubleshooting or replacement was maintained.

All the operational features of the fuze setter are shown in figure 18. The switches, displays, connectors, and operating instructions, that are necessary for operator use are depicted; they are essentially the same as the previous fuze setter design.

### 3.9 Design and Development of Remote Probe and Coil Cable

A remote probe and coil cable were designed and 13 units were fabricated. The remote probe and coil cable are shown in figures 19 and 20. Figure 21 illustrates the interconnection of the fuze setter and the remote probe using the coil cable. The remote probe and coil cable were designed to withstand the same environments as the fuze setter. The remote probe and coil cable were designed as separate units to allow effective waterproof probe design. Additional design considerations were ruggedness and compactness to properly fit the remote probe and coil cable into the carrying-case.

The remote probe design allows ease of fuze setting for various fuze field configurations and contains all the self-alignment features of the fuze setter guide to allow proper mechanical interface between the remote probe and the fuze. The coil cable was designed to meet the requirements of standard military specifications. A shielded cable was found to be necessary to concur with the Electromagnetic Interference (EMI) requirements for the fuze setter.

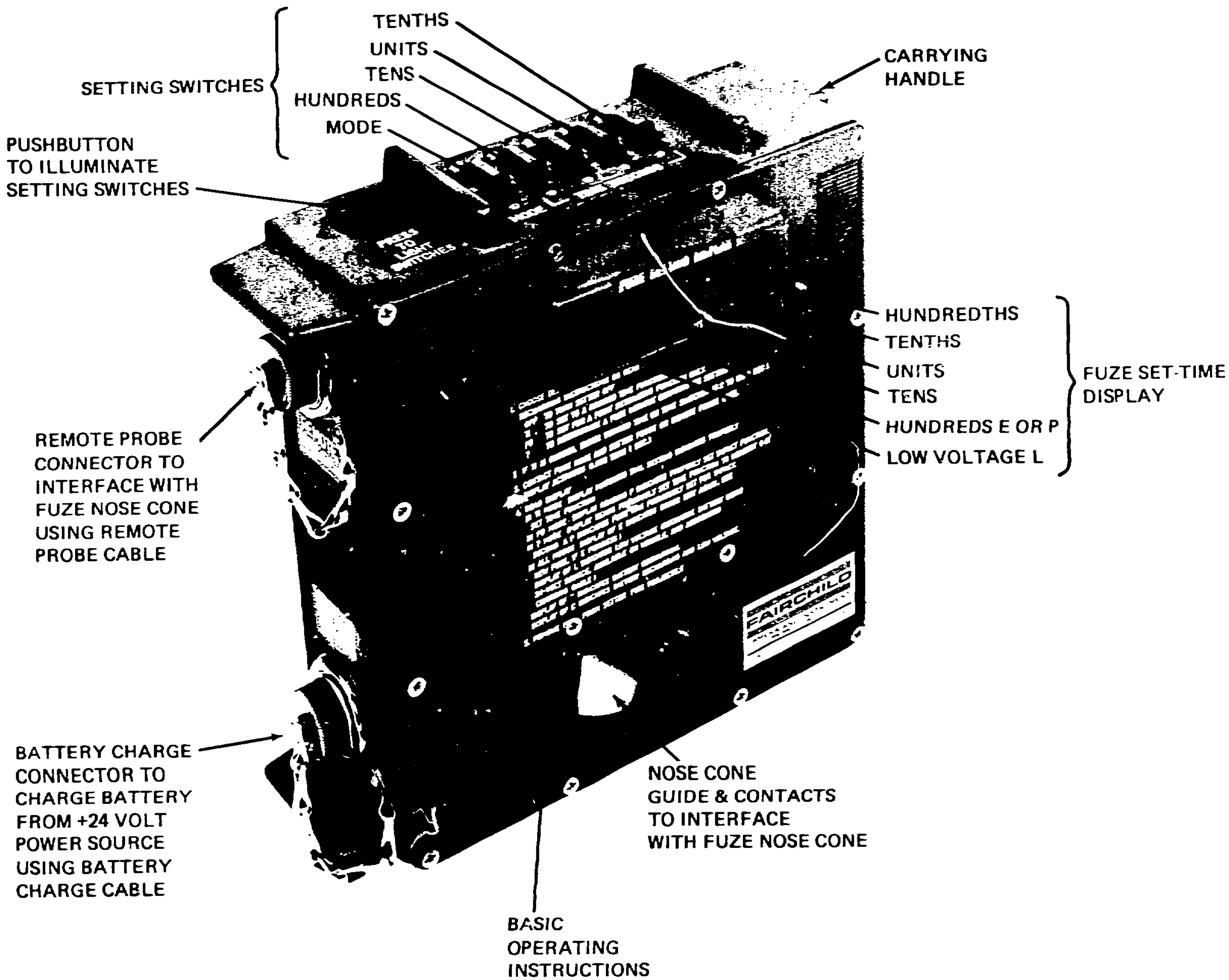


Figure 18. XM36El fuze setter operational features.


Figure 19. Remote probe.

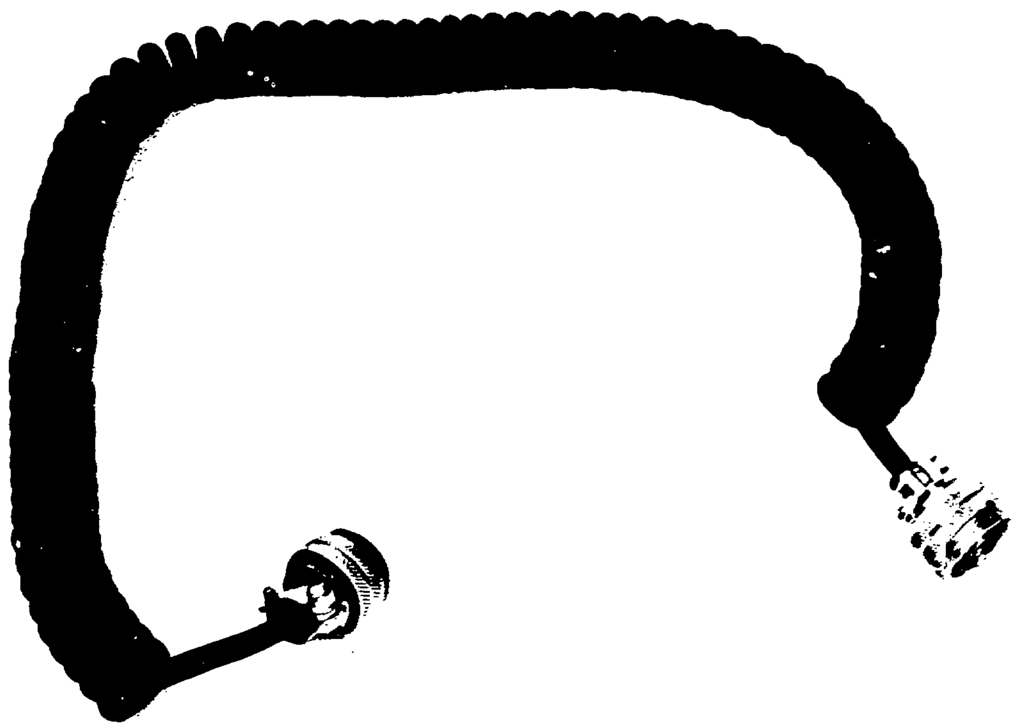

Figure 20. Coil cable.

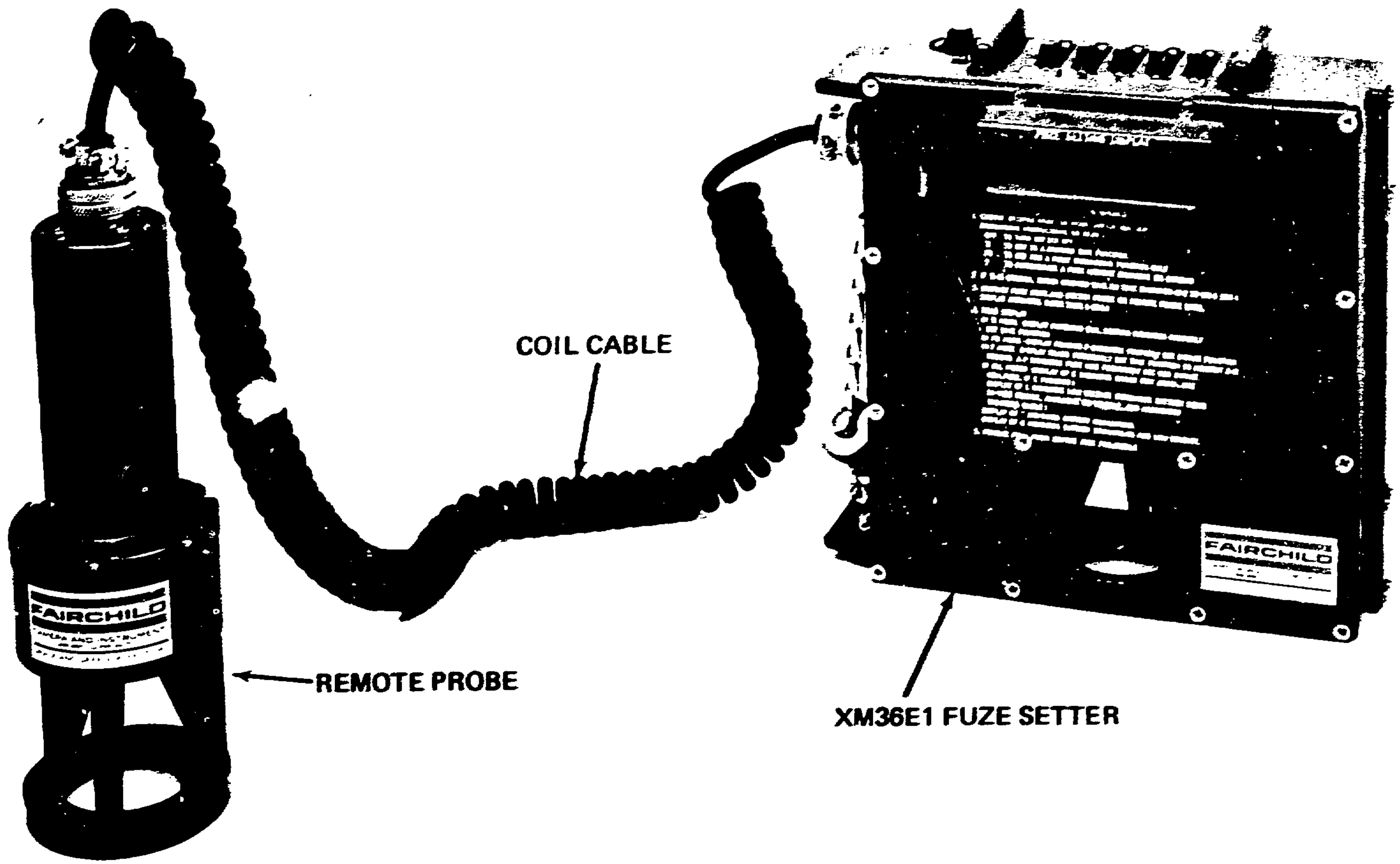


Figure 21. XM36E1 fuze setter and remote probe with coil cable.

### 3.10 Carrying-Case Redesign

The fuze setter carrying-case was redesigned and 13 units were fabricated, tested, and delivered. The design for this case was revised for it to contain the fuze setter, the battery charging cable, the remote probe, the coil cable, a bristle brush for cleaning the fuze-setter contacts, and a desiccant bag. Figures 22 and 23 show the external and internal views of the carrying-case.

The basic carrying-case was designed to use a larger, standard, long-intrusion-fuze ammunition can. The carrying-case insert was custom designed to house the various system components. Several insert materials were investigated to find a less dense material to reduce the overall carrying-case weight. However, the investigations showed that a change to a lighter-weight material would sacrifice the ruggedness and durability of the original design. Therefore, a silicone rubber material was maintained and, to minimize weight, lightening holes were strategically located wherever possible in the rubber insert walls. As a result, the pertinent features of this case maintain the characteristics of reusability, resilient insert material to minimize transportation shock, fungus resistance, and a completely sealed design, as well as a nonhygroscopic insert material, to prevent moisture absorption.

The carrying-case, with the fuze setter and its accessories, are shown in figure 24. The total weight of the carrying-case, the fuze setter, and its accessories is less than 25 lbs. This weight is comparable to that of the original system; however, this latest system design also includes a new remote probe and coil cable as well as a resultant larger carrying-case.

### 3-11 First Article Acceptance Sample (FAAS)

A test program was performed to verify the quality acceptance of three fuze setters which were submitted as FAAS units S/N 216, 217, and 301. These units were tested in accordance with revised Acceptance Test Procedure TP 11711348. These fuze setters were tested in accordance with phases 1 through 9 of that procedure as follows:


Figure 22. XM36E1 fuze setter carrying case--external view.

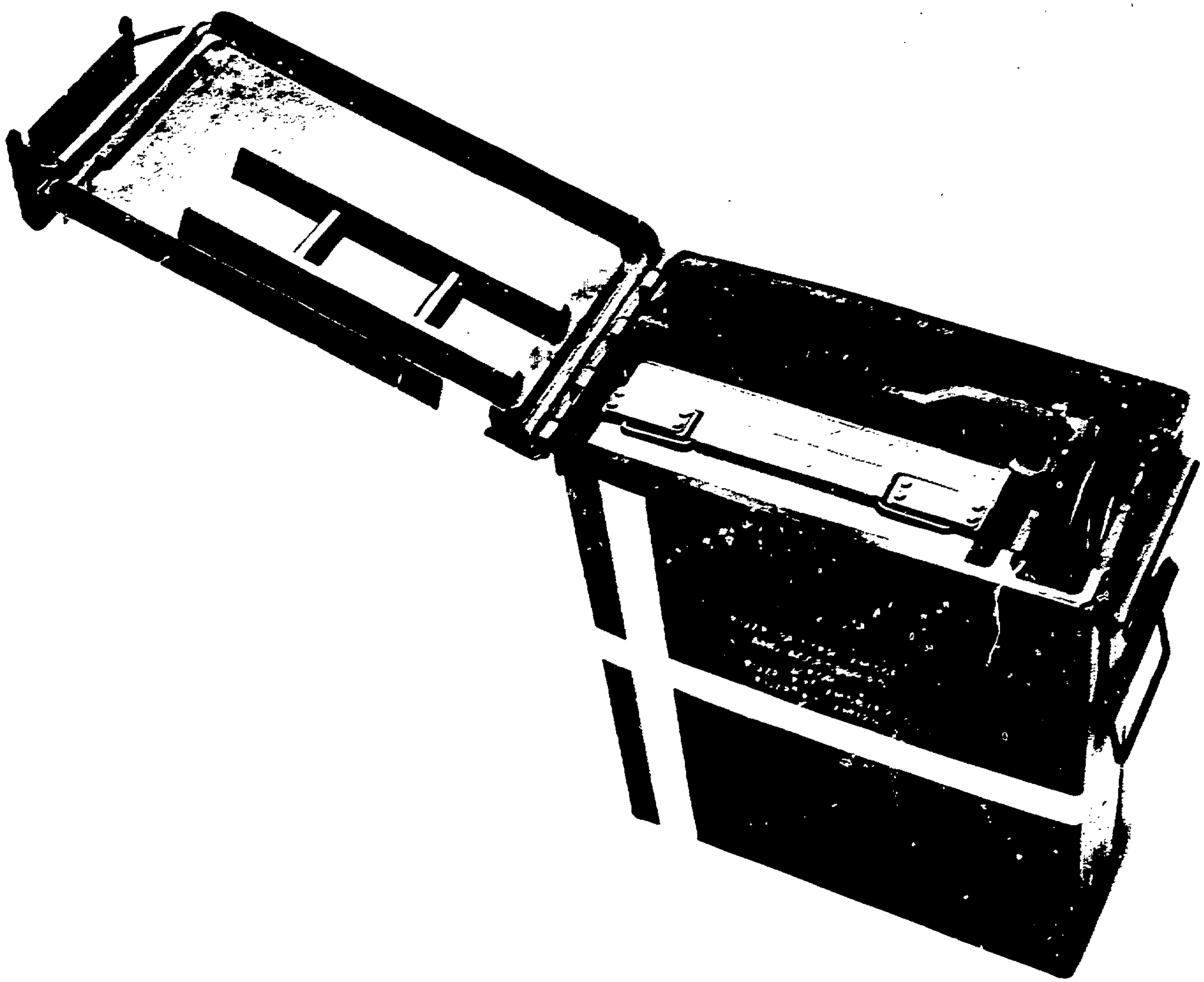

Figure 23. XM36E1 fuze setter carrying case--internal view.

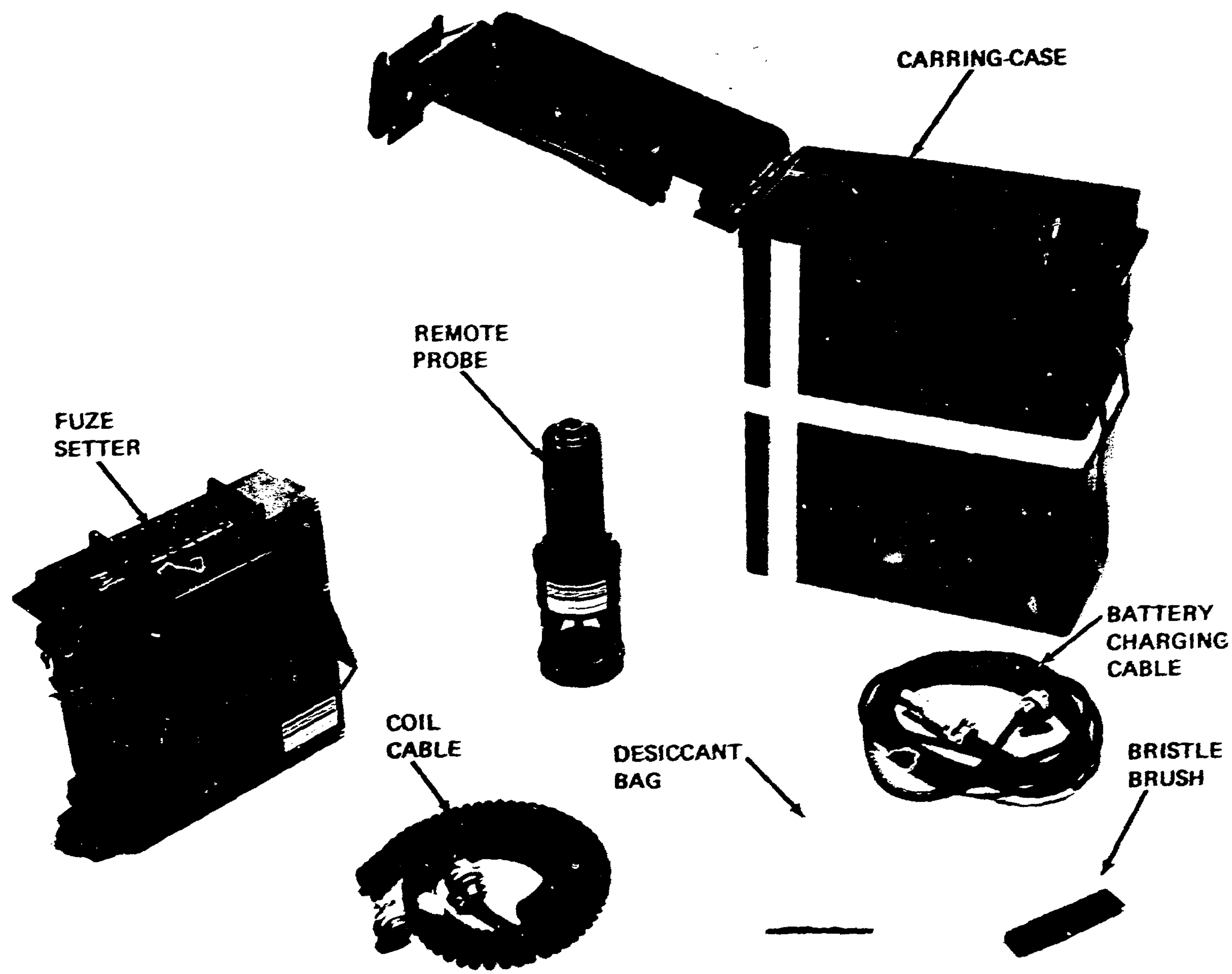


Figure 24. Carrying case with XM36E1 fuze setter and accessories.

| Environment | Fuze Setter, S/N |
|---|---|
| 1. Ambient temperature test | 216,217,301-311 |
| 2. Low-temperature test | 216,217,301-311 |
| 3. High-temperature test | 216,217,301-311 |
| 4. Leakage (immersion) test | 216,217,301 |
| 5. Dust (fine sand) test | 216,217 |
| 6. Humidity test | 216,217 |
| 7. Electromagnetic interference test | 301 |
| 8. Vibration (bounce) test | 216,217,301 |
| 9. Shock (drop) test | 216,217,301 |

The Shock and Vibration test for Fuze Setter S/N 301 was performed in the carrying-case with its accessories. The correct operation of the fuze setter was verified using the test setups shown in figures 25 and 26, after the setter was subjected to each of the environmental tests, as well as after significant stages of testing during each of the environments.

The test setup shown in figure 25 employs the nose cone to interface the fuze setter with the fuze circuitry. In figure 26, the remote probe and coil cable are used to interface the fuze setter with the fuze circuitry. In this manner, the operation of both the fuze setter setting contacts and the remote probe setting contacts is verified during various stages of testing.

Fuze Setters S/N 216,217, and 301 were initially fabricated using some substitute components. Use of these components maintained acceptable schedule requirements, permitting timely delivery of the three FAAS units. These substitute parts are listed below:

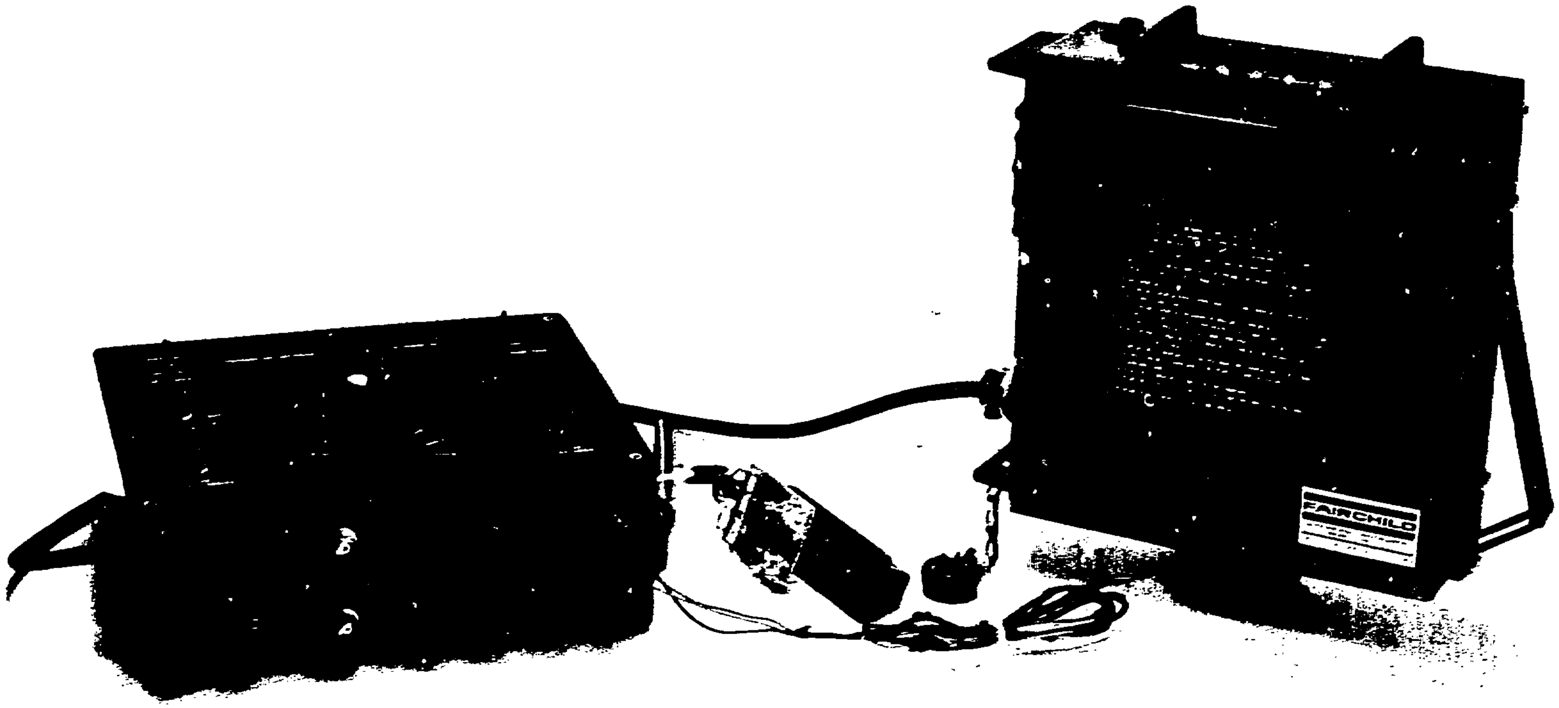


Figure 25. XM36E1 fuze setter and test setup (using fuze setter contacts).

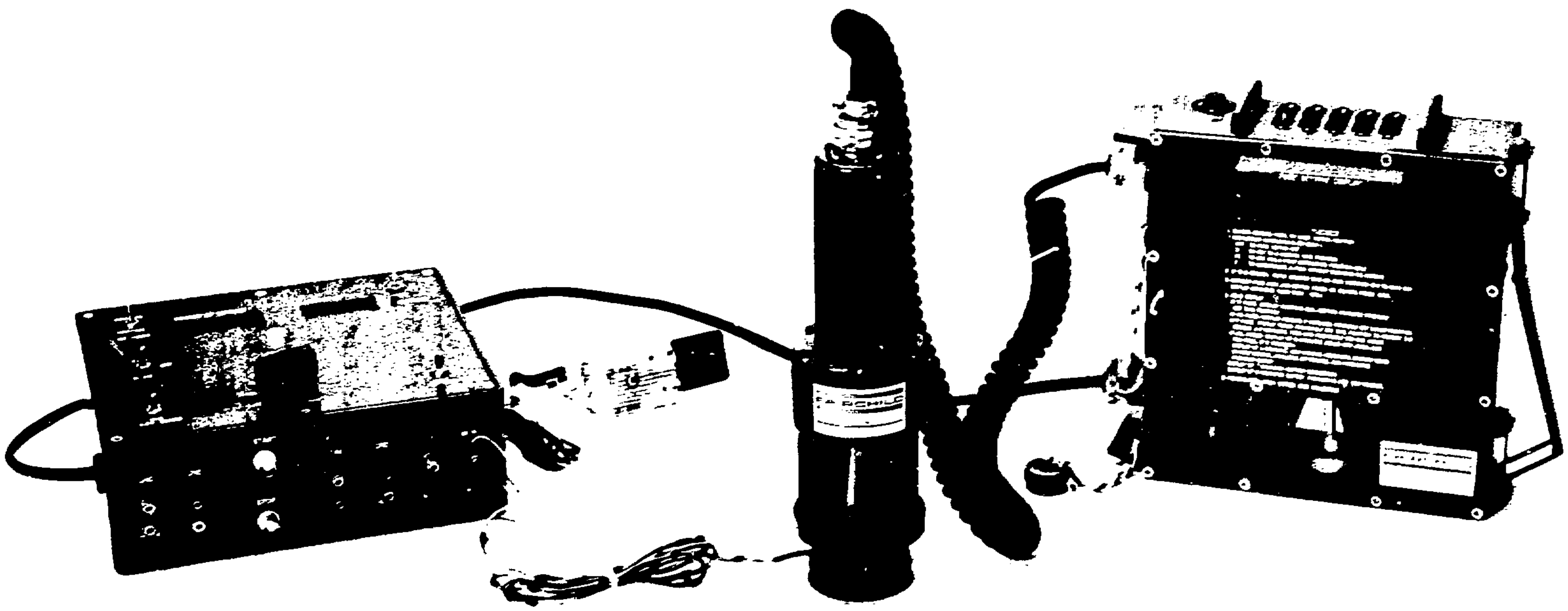

Figure 26. XM36E1 fuze setter and test setup (using remote probe).

| Item No. | Required P/N | Qty Per Unit | Substitute P/N | Unit Affected |
|---|---|---|---|---|
| 1 | JAN-TX-2N6059 | 1 | 2N6059 | Fuze Setter |
| 2 | 11711325F | 1 | 11711325D | Fuze Setter |
| 3 | MS27335T12A3SA | 1 | JT02RP-12-3SA | Remote Probe |

The substitute parts for items 2 and 3 have been replaced with the required parts after the FAAS tests. Item 1 has not been available to date and the substitute part has been maintained.

Following inspection and ambient tests, these units were tested in accordance with phases 1 through 9 of TP 11711348. These tests included the following temperatures and environments after baseline ambient data were taken:

(1) Low temperature in accordance with MIL-STD-810C, Method 502.1, Procedure I.

(2) High temperature in accordance with MIL-STD-810C, Method 501.1, Procedure I.

(3) Leakage in accordance with MIL-STD-810C, Method 512.1, Procedure I.

(4) Dust in accordance with MIL-STD-810C, Method 510.1.

(5) Humidity in accordance with MIL-STD-810C, Method 507.1, Procedure II.

(6) Electromagnetic interference in accordance with MIL-STD-461 and MIL-STD-462, Methods RE01, RE02, RS01, RS02, and RS03.

(7) Vibration in accordance with MIL-STD-810C, Method 514.2, Procedure XI.

(8) Shock in accordance with MIL-STD-810C, Method 516.2, Procedure II.

The results of the environmental tests proved satisfactory, with the following exceptions:

(1) The quartz crystal was out of tolerance in unit S/N 301 when the unit was operated at -40°C. [4]

(2) Water in the contact assembly of units S/N 216, 217, and 301 provided a resistive path between setting contacts, causing these units to malfunction. [5]

[4] Q&R Failure Report, Fairchild RF No. 6062-7, Feb 2, 1978.
[5] Q&R Failure Report, Fairchild RF No. 6062-8, Feb 9, 1978.

(3) A magnetic radiated emission exceeded specification limits in unit S/N 301 of test RS01. [6]

(4) Fuze Setter S/N 301 malfunctioned when used with the Remote Probe in an EMI field of Test RS03. [7]

(5) A wire broke during the vibration test in unit S/N 216. [8]

The following corrective action was taken for each malfunction.

(1) The quartz crystal was inspected and had a marginal solder connection, which is attributed to a vendor manufacturing defect.

(2) The setting contacts were coated with a paralene coating, thus minimizing exposed contact area and resistive paths.

(3) The magnetic limits specified by Test RE01 were considered to be low for the Fuze Setter field applications and a waiver was requested to delete this requirement.

(4) The remote probe coil cable was replaced with a shielded coil cable, thereby assuring successful results when retested.

(5) The broken wire was attributed to an insufficient service loop in the cable connection to a fuze setter connector, and provision for a service loop was more definitively specified in the assembly procedures.

A detailed description of the environmental tests for each fuze setter, S/N 216, 217, and 301 is contained in the Inspection Report data logbook for each unit and in the referenced failure reports. All corrective actions were incorporated in all the FAAS fuze setters where applicable, thereby concluding the environmental test program for these units.

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[6] Q&R Failure Report, Fairchild FR No. 6062-10, Feb 21, 1978.
[7] Q&R Failure Report, Fairchild FR No. 6062-11, Feb 21, 1978.
[8] Q&R Failure Report, Fairchild FR No. 6062-12, Mar 7, 1978.

### 3.12 Preproduction DT-II/OT-II

Upon completion and approval of the three FAAS Fuze Setters, S/N 216, 217, and 301, the preproduction DT-II/OT-II units were fabricated and tested. These 10 units were designated S/N 302 through 311 and incorporated all changes and revisions as a result of the FAAS tests. Preliminary, small-quantity production assembly procedures were revised and employed during fabrication. These units were subjected to the storage and operating temperature range and tested in accordance with phases 1 through 3 of TP 11711348. All results were satisfactory, with the following exception:

(1) Batteries in Fuze Setters S/N 304, 305 and 308 malfunctioned at a temperature of -40°C. [9]

The following corrective action was taken for this malfuction:

(1) The batteries were replaced, and an investigation of battery operation and characteristics of -40°C is being conducted.

A detailed description of the tests for each of the DT-II/OT-II Fuze Setters, S/N 302 through 311, is contained in the respective Inspection Report data logbooks, and the referenced Failure Report.

### 3.13 Fuze Setter Tests with Test Console

In addition to the acceptance tests performed per TP11711348, other tests were found to be necessary which would verify other requirements of the fuze setter specification MIL-F-48701(MU) Revision B, dated 6 December 1977. These tests consisted of the verification of the electrical characteristics of the fuze interface signals. The test setup for these measurements is shown in figure 27. The test console illustrated here was supplied by HDL. Since one of the tests performed required a fuze oscillator at several different frequency values, a variable frequency oscillator was designed and incorporated in the test console. The schematic diagram for this design is shown in figure 28. Power for this circuit is received from the Vx signal normally supplied by the fuze setter under test.

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[9] Q&R Failure Report, Fairchild FR No. 6062-13, Mar 6, 1978.

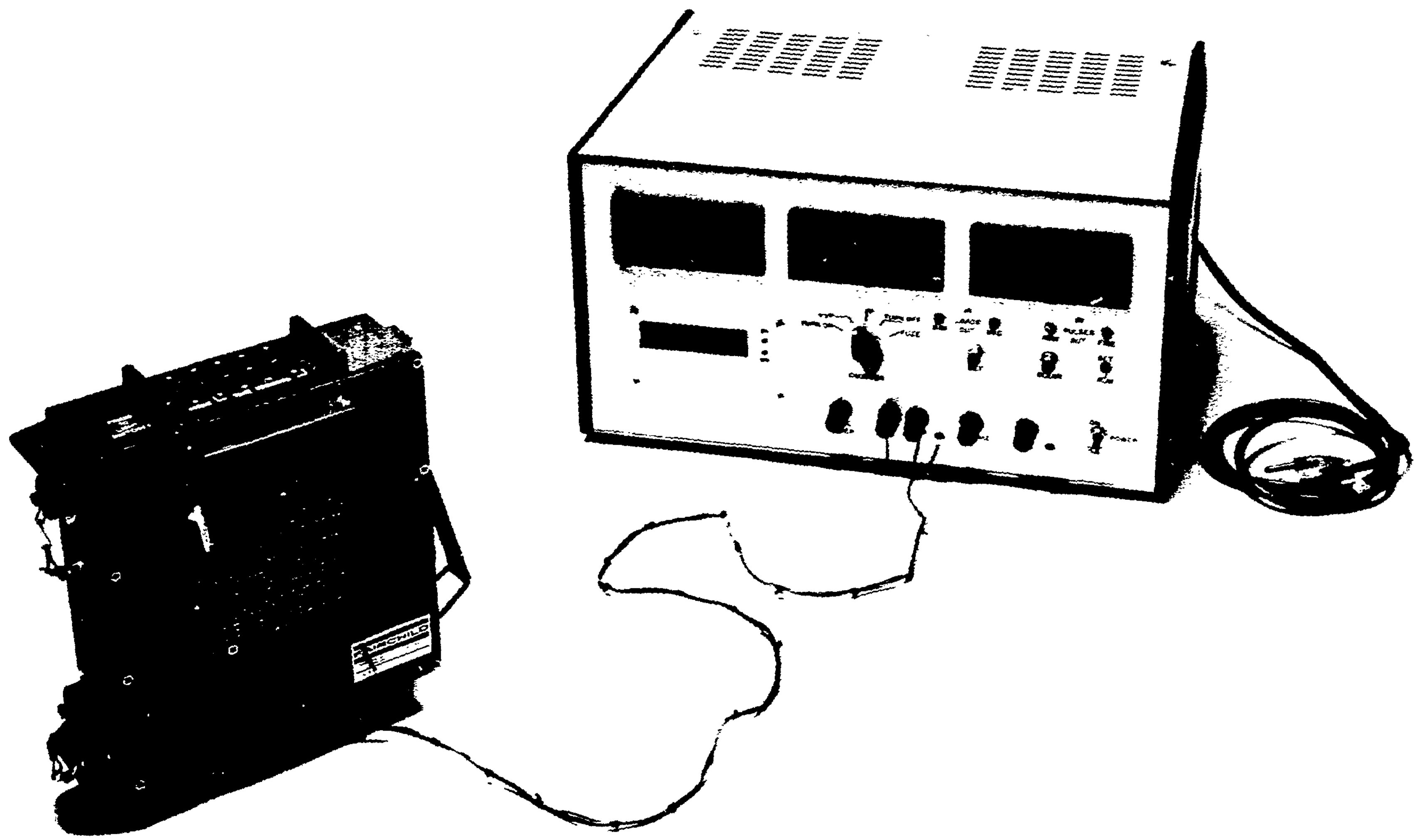

Figure 27. XM36E1 fuze setter and test setup (using test console).

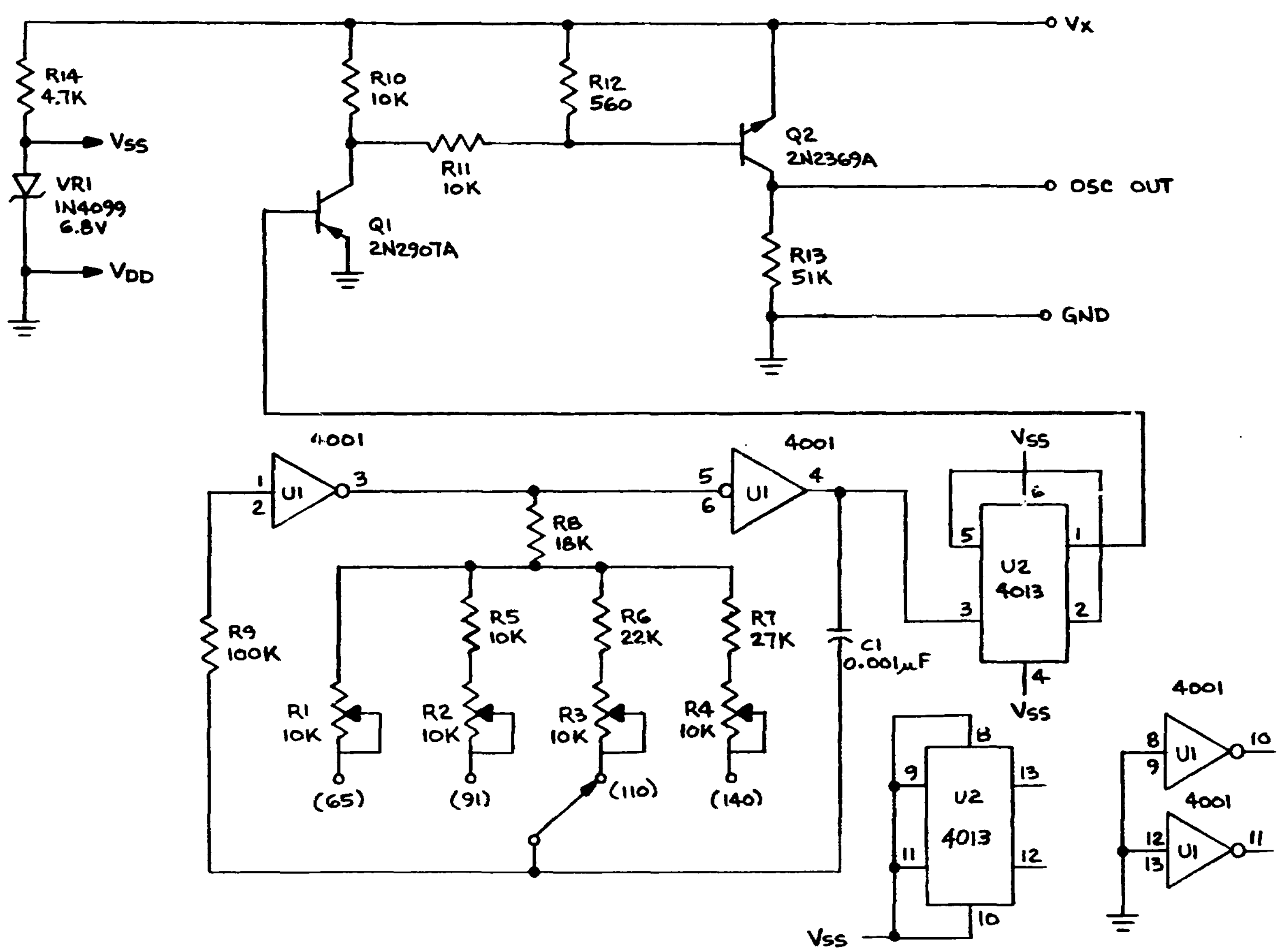


Figure 28. Test console variable-frequency fuze oscillator.

The basic oscillator consists of an RC CMOS oscillator, U1. The frequency is varied by means of a four-position resistor selector switch. The oscillator output is transmitted to a flip-flop, U2, which divides the oscillator frequency providing a 50% duty cycle. This flip-flop output is then voltage amplified by transistors Q1 and Q2 to provide the required signal for the test console fuze. Power for the integrated circuits is derived from the Vx signal and regulated by zener diode VR1 to 6.8 V.

Calibration trimming resistors, R1 thorugh R4, are provided to adjust each selected oscillator frequency to the worst-case fuze setter limits, as described in the previous pulse-width circuit revision paragraph. Two of these limits are set to periods of 65 and 140 $\mu$s, which will check that the fuze setter displays an "E". The other two limits are set to periods of 91 and 110 $\mu$s, which check that the fuze setter will display the set time. The above settings are based on the digital pulse-width circuit design, allowing for rise and fall times of the discrete components in the fuze setter interface circuit.

The fuze setter electrical tests performed by the test console include the measurement of the $+V_P$, $-V_P$, and $-V_X$ voltage magnitudes and the measurement of the $+V_P$ and $-V_P$ pulse widths. The specification for the voltage range of these interface signals is governed by the fuze component design. The magnitude of the $+V_P$ and $-V_P$ voltages is required to be between 26 and 32 V and the $-V_X$ signal is required to be between -22.5 and -28.5 V.

An investigation was conducted for the selection of components that would maintain the $+V_P$ and $-V_P$ signals between 26 and 32 V over the operating temperature range of -40° to +63°C. A comparison of three components was studied, namely, a 5% temperature-compensated reference diode, a 2% zener diode, and a 1% zener diode. The results of this comparison, along with the basic assumptions, are shown in figure 29. It was determined that the 1% zener diode be selected, since its performance meets the above requirements with some safety margin. Also shown are the effects of these three components on the requirements of the $-V_X$ signal. It should be noted that the 1% zener diode best satisfies the $-V_X$ signal specification. The upper limit, however, is slightly out of tolerance under worst-case conditions. If the effect of this condition on the fuze is significant, it should be further investigated.

Test results for all the tests performed with the test console are recorded in the Inspection Report data logbooks for each fuze setter.

| ITEM | VOLT. (V) | TOLER (V) | T. C. (mv/°C) |
|---|---|---|---|
| $V_Z$ (2%) | 30 | ±0.6 | +27.4 |
| $V_Z$ (1%) | 30 | ±0.3 | +27.4 |
| $V_{REF}$ (5%) | 30 | ±1.5 | + 1.5 |
| $V_D$ | 0.7 | ±0.1 | -2.3 |
| $V_{BE}$ | 0.7 | ±0.1 | -2.3 |
| $V_{CE}$ | 0.2 | ±0.1 | +0.1 |

$+V_P = +\left[V_Z - (V_{BE} + V_{CE})\right]$ $\quad\quad$ $-V_P = -\left[V_Z - (V_{BE} + V_{CE})\right]$

$|V_P| = \left[30\pm0.6 - (0.7\pm0.1 + 0.2\pm0.1)\right] =$ 29.1±0.8V (2% Zener)

$TC = +27.4+2.3 = +29.7$ mv/°C $=$ +1.1V at +63°C, -1.9V at -40°C (Zener)

$TC = +1.5 + 2.3 - +3.8$ mv/°C $=$ +0.2V at +63°C, -0.3V at -40°C (Refer.)

| | 2% ZENER | 1% ZENER | 5% REFERENCE | SPEC. |
|---|---|---|---|---|
| $\lvert V_P max\rvert$ | = +29.1 + 0.8 + 1.1 = $\boxed{31.0V}$ | =+29.1+0.5+1.1 = $\boxed{30.7V}$ | = +29.1+1.7+0.2 = $\boxed{31.0}$ | $\boxed{32.0}$ |
| $\lvert V_P min\rvert$ | = +29.1 - 0.8 - 1.9 = $\boxed{26.4V}$ | =+29.1-0.5-1.9 = $\boxed{26.7V}$ | = +29.1-1.7-0.3 = $\boxed{27.1}$ | $\boxed{26.0}$ |

$-V_X = -\left[V_Z - (2V_{BE} + V_{CE} + 3v_D)\right]$

$-V_X = -\left[30\pm0.6 - (1.4\pm0.2 + 0.2\pm0.1 + 2.1\pm0.3)\right] = -26.3 \pm 26.3\pm1.2V$ (2% ZENER)

$TC_X = +27.4+4.6+6.9 = +38.9$ mv/°C = +1.5v at +63°C, - 2.5V at -40°C (ZENER)

$TC = +1.5 + 4.6 + 6.9 = +13.0$ mv/°C = +0.5V at +63°C, -0.9 at -40°C (REFER)

| | 2% ZENER | 1% ZENER | 5% REFERENCE | SPEC. |
|---|---|---|---|---|
| $-V_X max$ | = - 26.3-1.2-1.5 = $\boxed{-29.0V}$ | = -26.3-0.9-1.5= $\boxed{-28.7V}$ | = -26.3-2.1-0.5= $\boxed{-28.9V}$ | $\boxed{-28.5V}$ |
| $-V_X min$ | = - 26.3-1.2+2.5 = $\boxed{-22.6V}$ | = -26.3+0.9+2.5= $\boxed{-22.9V}$ | = -26.3+2.1+0.9= $\boxed{-23.3V}$ | $\boxed{-22.5V}$ |

Figure 29. Worst-case + $V_P$, $-V_P$, $-V_X$ voltages.

### 3.14 Engineering Change Proposals (ECP's)

During this program several drawing revisions were required. Minor changes were needed in some of the piece parts to improve design, ease fabrication, and correct minor errors. Requests for these changes were submitted via Engineering Change Proposals (ECP's).

The four major changes requiring ECPS's were:

(1) Incorporation of latest battery charging circuit design.

(2) R vision of pulse-width circuit.

(3) Revision of mode-setting switch, and

(4) Allowance for an alternate display readout window material.

A summary of all ECP's for the fuze setter generated during this program is listed in table II.

Other changes were also required for some of the fuze setter's associated equipment. These revisions basically consisted of the addition of the remote probe and coil cable, revision of the carrying-case assembly, and the deletion of the operating instruction card. These changes were also requested via ECP's. A summary of the ECP's for the fuze setter's associated equipment is listed in table III.

### 3.15 Drawing Lists

Various changes and improvements have been incorporated in the fuze setter during this program. As previously mentioned, these changes have been covered in detail by ECP's. A list of drawings representing the 13 fuze setters, S/N 216, 217, and 301 through 311 is shown in table IV. The list of drawings representing the auxiliary equipment for these 13 fuze setters is shown in table V.

## 4. CONCLUSIONS AND RECOMMENDATIONS

### 4.1 Conclusions

The following conclusions are derived from the tasks performed during this program:

(1) The three FAAS fuze setters, S/N 216, 217 and 301, which were subjected to the environmental test program, show that the latest design will withstand the environments normally encountered in artillery field use.

TABLE II. ENGINEERING CHANGE PROPOSALS FOR FUZE SETTER: XM36E1

| Dwg. No. | ECP. No. | Revisions From | Revisions To |
|---|---|---|---|
| 11711348 | 036-DCE-046 | E | F |
| | 036-DAE-015-4 | F | G |
| | 036-DAE-020-9 | G | H |
| | 036-DAE-022-1 | H | J |
| | 036-FSD-037A-1 | J | K |
| | 036-DAE-031-1 | K | L |
| 11711327 | 036-DCE-046 | G | H |
| | 036-DAE-020-10 | H | J |
| | 036-FSD-016A-1 | J | K |
| | 036-DAE-026-5 | K | L |
| | 036-FSD-031A-1 | L | M |
| | 036-DAE-032-2A | M | N |
| 11711357 | 036-DCE-004 | D | E |
| | 036-DAE-021-3 | E | F |
| | 036-DAE-022-2 | F | G |
| | 036-FSD-040A-1 | G | H |
| 11711344 | 036-FSD-001-1 | F | G |
| | 036-FSD-007-1 | G | H |
| | 036-FSD-008-1 | H | J |
| | 036-FSD-042A-1 | J | K |
| 11711353 | 036-FSD-005-1 | B | C |
| 11711363 | 036-DAE-029-5 | - | A |
| 11711325 | 036-FSD-004-1 | D | E |
| | 036-DAE-031-8 | E | F |
| 11711328 | 036-FSD-003-1 | D | E |
| | 036-FSD-032A-1 | E | F |
| 11711339 | 036-DAE-021-12 | B | C |
| 11711347 | 036-DCE-003 | C | D |
| | 036-DAE-020-2 | D | E |
| 11711346 | 036-DCE-003 | A | B |
| | 036-DAE-020-6 | B | C |
| 11711342 | 036-DAE-020-7 | D | E |
| | 036-DAE-035A-1 | E | F |
| 11711343 | 036-DAE-021-9 | D | E |
| | 036-FSD-036A-1 | E | F |
| 11711355 | 036-DAE-021-11 | C | D |
| | 036-FSD-049-1 | D | E |
| 11711351 | 036-DAE-021-10 | E | F |
| 11711362 | 036-FSD-020A-1 | - | A |

TABLE II. ENGINEERING CHANGE PROPOSALS FOR FUZE SETTER: XM36E1 (cont'd)

| Dwg. No. | ECP. No. | Revisions From | Revisions To |
|---|---|---|---|
| 1711356 | 036-DCE-005 | B | C |
| | 036-DAE-021-2 | C | D |
| | 036-DAE-022-3 | D | E |
| | 036-DAE-026-4 | E | F |
| | 036-FSD-039A-1 | F | G |
| 11711361 | 036-DCE-046 | C | D |
| | 036-FSD-002-1 | D | E |
| | 036-DAE-021-4 | E | F |
| | 036-DAE-029-1 | F | G |
| | 036-FSD-043A-1 | G | H |
| 11711354 | 036-DCE-046 | E | F |
| | 036-DAE-020 | F | G |
| | 036-FSD-021A-1 | G | H |
| | 036-FSD-038A-1 | H | J |
| 11711358 | 036-DAE-028-4 | C | D |
| 11726822 | 036-DAE-028-6 | - | A |
| | 036-FSD-047A-1 | A | B |
| 11711360 | 036-DCE-046 | D | E |
| | 036-DAE-020-5 | E | F |
| 11711305 | 036-DAE-020-1 | A | B |
| 11711318 | 036-DAE-015-3 | C | D |
| | 036-DAE-021-1 | D | E |
| | 036-DAE-022-4 | E | F |
| | 036-DAE-026-3 | F | G |
| | 036-FSD- 030A-1 | G | H |
| 11711320 | 036-DAE-028-2 | B | C |
| 11711315 | 036-DAE-015-2 | D | E |
| | 036-DAE-021-5 | E | F |
| | 036-FSD-015A-1 | F | G |
| | 036-DAE-026-1 | G | H |
| | 036-FSD-027A-1 | H | J |
| 11711335 | 036-FSD-017A-1 | B | C |
| | 036-FSD-026A-1 | C | D |
| 11711326 | 036-DAE-020-8 | B | C |
| 11711359 | 036-DCE-001 | - | A |
| | 036-DCE-046 | A | B |
| | 036-DAE-028-12 | B | C |
| 11711316 | 036-DAE-021-6 | D | E |
| | 036-FSD-014A-1 | E | F |
| | 036-DAE-026-2 | F | G |
| | 036-FSD-028A-1 | G | H |
| 11711336 | 036-FSD-018A-1 | B | C |
| | 036-FSD-026A-2 | C | D |

TABLE II. ENGINEERING CHANGE PROPOSALS
FOR FUZE SETTER: XM36E1 (cont'd)

| Dwg. No. | ECP. No. | Revision From | Revision To |
|---|---|---|---|
| 11711317 | 036-DAE-015-1 | D | E |
| | 036-FSD-013-1A | E | F |
| | 036-DAE-024-1 | F | H |
| | 036-FSD-029A-1 | H | J |
| | 036-DAE-032-3A | J | K |
| 11711337 | 036-FSD-019A1 | A | B |
| | 036-FSD-026A-3 | B | C |
| 11711330 | 036-DAE-021-15 | B | C |
| | 036-FSD-033A-1 | C | D |
| 11711329 | 036-DAE-028-3 | B | C |
| 11711332 | 036-DAE-021-13 | - | A |
| 11711308 | 036-DAE-021-16 | - | A |
| 11711331 | 036-DAE-021-14 | - | A |
| | 036-FSD-034A-1 | A | B |
| 11711314 | 036-DAE-028-1 | A | B |

## TABLE III. ENGINEERING CHANGE PROPOSALS FOR FUZE SETTER ASSOCIATED EQUIPMENT

| Dwg. No. | ECP. No. | Revision From | Revision To |
|---|---|---|---|
| | FUZE SETTER & ACCESSORIES | | |
| 11711372 | 036-DAE-025-1 | - | A |
| | 036-FSD-024-1 | A | B |
| | 036-DAE-033-1 | B | C |
| | REMOTE PROBE | | |
| 11726819 | 036-DAE-028 | - | A |
| 11726817 | 036-DAE-028-7 | - | A |
| | 036-FSD-044A-1 | A | B |
| 11726818 | 036-DAE-028-8 | - | A |
| | 036-FSD-045A-1 | A | B |
| | 036-DAE-034-1 | B | C |
| | REMOTE PROBE CABLE | | |
| 11726821 | 036-DAE-028-11 | - | A |
| | 036-FSD-048-1 | A | B |
| 11726820 | 036-DAE-028-10 | - | A |
| | 036-FSD-046A-1 | A | B |
| | 036-FSD-050-1 | B | C |
| | BATTERY CHARGE CABLE | | |
| 11711399 | FSD-FS-012 | A | B |
| | 036-DAE-020-3 | B | C |
| | 036-FSD-041A-1 | C | D |
| 11711722 | 036-DCE-046 | - | A |
| | 036-DAE-023-1 | A | B |
| | GO-GAGE | | |
| 11711379 | 036-DAE-017-3 | A | B |
| 11711377 | 036-DAE-017-1 | - | A |
| 11711389 | 036-DAE-017-13 | A | B |
| | 036-DAE-030-1 | B | C |
| 11711387 | 036-DAE-017-11 | - | A |
| 11711378 | 036-DAE-017-2 | A | B |
| 11711383 | 036-DAE-017-7 | A | B |
| 11711382 | 036-DAE-017-6 | A | B |
| 11711381 | 036-DAE-017-5 | A | B |
| 11711380 | 036-DAE-017-4 | A | B |
| | NO-GO GAGE | | |
| 11711390 | 036-DAE-017-14 | A | B |
| 11711389 | 036-DAE-017-13 | A | B |
| | 036-DAE-030-1 | B | C |
| 11711388 | 036-DAE-017-12 | A | B |
| 11711387 | 036-DAE-017-11 | - | A |
| 11711386 | 036-DAE-017-10 | - | A |
| 11711385 | 036-DAE-017-9 | - | A |
| 11711384 | 036-DAE-017-8 | - | A |

TABLE IV. FUZE SETTER: XM36E1-DRAWING LIST (S/N 216, 217, 301-311)

| Dwg. No. | Rev. | Title |
|---|---|---|
| F11711348 | L | FUZE SETTER: XM36E1 ASSEMBLY |
| F11711327 | N | FUZE SETTER: XM36E1 DETAILED LOGIC DIAGRAM |
| F11711357 | H | FUZE SETTER: XM36E1, WIRING DIAGRAM |
| F11711344 | K | HOUSING FUZE SETTER |
| F11711353 | C | COVER BATTERY |
| B11711306 | | CUSHION, BATTERY |
| B11711307 | | GASKET, PUSHBUTTON |
| C11711363 | A | GASKET, SWITCH |
| D11711325 | F | SWITCH, ROTARY |
| D11711328 | F | BATTERY, SEALED CELL |
| C11711339 | C | CAP, ELECTRICAL CONNECTOR |
| B11711347 | E | PLATE, HANDLE |
| C11711346 | C | HANDLE |
| B11711345 | | LINK, HANDLE |
| C11711342 | F | COVER, CONTACT |
| D11711343 | F | RETAINER, CONTACT |
| C11711355 | E | CONTACT |
| D11711351 | F | GASKET, PANEL |
| F11711362 | A | PRINTED WIRING MASTER, CONTACT SEAL |
| C11711369 | | INSULATOR |
| F11711356 | G | PANEL ASSEMBLY |
| F11711361 | H | PANEL, FRONT |
| C11711354 | J | FILTER, ANTI-REFLECTION |
| C11711358 | D | ACRYLIC SUBSTRATE |
| C11726822 | B | LIGHT CONTROL FILM |
| C11711360 | F | GASKET, FILTER |
| B11711305 | B | SPACER |
| F11711318 | H | ELECTRONIC BOARD ASSEMBLY |
| C11711320 | C | JUMPER, PRINTED CIRCUIT BOARD |
| D11711315 | J | DISPLAY LOGIC BOARD ASSEMBLY |
| F11711335 | D | PRINTED WIRING MASTER, DISPLAY LOGIC |
| D11711326 | C | DISPLAY, SEVEN SEGMENT |
| A11711359 | C | MICROCIRCUIT, DIGITAL, CMOS, DECADE COUNTER/ DIVIDER, MONOLITHIC SILICON |
| D11711316 | H | CONTROL LOGIC BOARD ASSEMBLY |
| F11711336 | D | PRINTED WIRING MASTER, CONTROL LOGIC |
| D11711317 | K | POWER & INTERFACE BOARD ASSEMBLY |
| F11711337 | C | PRINTED WIRING MASTER, POWER & INTERFACE CIRCUITS |
| C11711330 | D | TRANSFORMER ASSEMBLY |
| C11711329 | C | ENCAPSULATION CUP |
| C11711332 | A | ENCAPSULATION CUP, ALTERATION |
| C11711308 | A | TERMINAL |
| C11711331 | B | TRANSFORMER, TOROIDAL |
| C11711314 | B | CORE, MAGNETIC |

TABLE V. FUZE SETTER: XM36E1
AUXILIARY EQUIPMENT DRAWING LIST

| Dwg. No. | Rev. | Title |
|---|---|---|
| F11711372 | C | FUZE SETTER: XM36EL AND ACCESSORIES |
| F11726825 | | CARRYING CASE, FUZE SETTER: XM36E1 |
| F11726823 | | COVER INSERT |
| F11726823 | | PACKAGING INSERT |
| | | |
| F11726888 | | SHIPPING & STORAGE CONTAINER ASSEMBLY |
| F11726871 | | COVER ASSEMBLY |
| D11726872 | | COVER |
| C11726873 | | HINGE, COVER |
| C11726874 | | CLIP, COVER HANDLE |
| C11726875 | | HANDLE, COVER |
| C11726876 | | LINK, COVER HANDLE |
| C11726877 | | LATCH |
| C11726878 | | LINK, LATCH |
| C11726880 | | RETAINER, GASKET |
| C11726881 | | GASKET, COVER |
| F11726882 | | BODY ASSEMBLY |
| F11726883 | | BODY |
| C11726884 | | HASP |
| C11726885 | | PIN, HINGE |
| C11726886 | | HINGE, BODY |
| C11726887 | | BOTTOM |
| | | |
| D11726819 | A | REMOTE PROBE ASSEMBLY, FUZE SETTER: XM36E1 |
| D11726817 | B | GUIDE, PROBE |
| D11726818 | C | HANDLE, PROBE |
| | | |
| D11726821 | B | CABLE ASSEMBLY, REMOTE PROBE |
| D11726820 | C | CABLE, RETRACTILE |
| | | |
| C11711399 | D | CABLE, BATTERY CHARGE |
| C11711722 | B | ADAPTER, CHARGING CABLE |
| C5328302 | A | PLUG |
| | | |
| F11711379 | B | "GO" GAGE, GUZE SETTER |
| D11711377 | A | "GO" GAGE SCHEMATIC DIAGRAM |
| F11711389 | C | NOSE CONE, GAGE |
| C11711387 | | CAP, TRANSLUCENT |
| D11711378 | B | "GO" GAGE BOARD ASSEMBLY |
| F11711376 | B | PRINTED WIRING MASTER, GO GAGE |
| C11711383 | B | RING ASSEMBLY, CONTACT |
| C11711382 | B | ADAPTER, CONTACT MOUNTING |
| B11711381 | B | CONTACT, CENTER |
| C11711380 | B | RING, CONTACT |
| | | |
| F11711390 | B | "NO GO" GAGE, FUZE SETTER |
| F11711389 | C | NOSE CONE, GAGE |
| D11711388 | B | ADAPTER, CONTACT |
| C11711387 | A | CAP, TRANSLUCENT |
| C11711386 | A | CLIP, LAMP |
| B11711385 | A | CUSHION, BATTERY |
| C11711384 | A | BATTERY, "D" SIZE |

(2) The 10 DT-II/OT-II preproduction fuze setters, S/N 302 through 311, show that the fuze setter technical data package provides satisfactory information for the fabrication of production quantities of the fuze setter for field applications.

(3) The tests performed on the fuze setter confirm that the latest design provides the operator with all of the features and instructions necessary for field use.

(4) The fuze setter test program shows that a safe and reliable quality product can be produced with the use of the present tooling and gages employed during fuze setter fabrication.

(5) The modification of the battery charging circuit extended the charging temperature range so that the complete operating temperature range for both charge and discharge of the entire fuze setter is from -40° to +145°F. The latest batteries supplied by the manufacturer have been tested and found to operate unsatisfactorily at low temperatures. An investigation to resolve this problem is currently in progress.

(6) Incorporation of a battery charging indicator satisfactorily informs the operator that current from an external source is being supplied to the battery.

(7) The electrical tests performed on the fuze setter confirm that all fuzes manufactured within worst-case limits will be correctly set and those fuzes exceeding specified limits will be rejected by the fuze setter.

(8) The revision of the fuze setter mode switch to delete the self-check test modes still allows satisfactory operation for field use.

(9) Testing of the fuze setter and analytical studies showed that the original display readout window material, in conjunction

with the hood of the cast panel, allowed the display to be visible in bright sunshine, bright cloudy weather, and on dark overcast days; and that the alternate grated-type window material did not enhance readability of the display. Sample units of each type have been provided, however, and final judgment should be reserved for the field users.

(10) The addition of the remote probe and coil cable proved useful in providing the fuze setter with the ability to remotely set fuzes.

(11) The fuze setter accessories -- including the carrying-case, remote probe, coil cable, battery charging cable, and bristle brush for cleaning the contacts--supplement the fuze setter, providing a complete system for field applications.

## 4.2 Recommendations

The following suggestions are recommended to aid in the fabrication of production quantities of the fuze setter for use in the field.

(1) Submit supplied sample fuze setters to type classification program consisting of Development Test (DT-II) and Operation Test (OT-II) test phases to qualify the fuze setter for production.

(2) Fabricate, test, and deliver an initial production quantity of fuze setters in accordance with the technical data package to show feasibility of large production quantities.

(3) The fuze setter assembly and manufacturing procedures should be reviewed from a production engineering standpoint to provide a more cost-effective unit for large production quantities.

(4) A study should be initiated to determine the requirements for the design and development of production test equipment for the fuze setter, which would aid in minimizing the production costs for the fuze setter.

(5) A product improvement program should be initiated to investigate the possible implementation of a more efficient, cost-effective, latest state-of-the-art fuze setter design.

(6) A study should be initiated to determine the possible use of the fuze setter in applications that require the automated setting of fuzes, or have the operator assisted by a computer, or both. The investigation to resolve the unsatisfactory operation of the battery at low temperatures should be continued.

The enactment of these suggestions will further enhance the fuze setter system, providing a more suited product for artillery field employment.

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